LECTURES

ON

ORTHOPÆDIC SURGERY

LECTURES

ON

ORTHOPÆDIC SURGERY

DELIVERED AT ST GEORGE'S HOSPITAL

BY

BERNARD E. BRODHURST, F.R.C.S.,

SURGEON TO THE ROYAL ORTHOPÆDIC HOSPITAL; CONSULTING SURGEON TO THE BELGRAVE HOSPITAL FOR CHILDREN; LATE SURGEON TO THE ORTHOPÆDIC DEPARTMENT OF, AND LECTURER ON ORTHOPÆDIC SURGERY AT, ST. GEORGE'S HOSPITAL; FOREIGN ASSOCIATE OF THE ACADEMY OF SCIENCES OF ROME; CORRESPONDING MEMBER OF THE IMPERIAL SOCIETY OF SURGERY OF PARIS, AND OF THE IMPERIAL MEDICAL AND SURGICAL SOCIETIES OF LYONS, ROME, AND ODESSA, ETC. ETC. ETC.

SECOND EDITION

LONDON

J. & A. CHURCHILL, NEW BURLINGTON STREET

1876

PREFACE

TO THE

SECOND EDITION

ANOTHER edition having been called for, I have made some few alterations in preparing it for the press. In other respects the volume retains the same form as before. It consists of three parts, namely; Deformities and Contractions of the Limbs; Diseases of the Joints, and Curvatures of the Spine.

20, GROSVENOR STREET;
August, 1876.

CONTENTS

PART I

DEFORMITIES AND CONTRACTIONS OF THE LIMBS

PART II

DISEASES OF THE JOINTS

PART III

CURVATURES OF THE SPINE

ORTHOPÆDIC SURGERY

PART I

DEFORMITIES OF THE LIMBS

CHAPTER I

INTRODUCTORY

Orthopædic surgery comprises the treatment of deformities of the trunk, neck, and extremities; such as club-foot in its several varieties, contractions of the limbs, curvatures of the spine, wry neck, deformities arising from rickets, and from cicatrices of burns, ankyloses, old dislocations, congenital dislocations, &c. Those deformities which arise during embryonic or fœtal life exist at birth, and are therefore termed *congenital;* while *non-congenital* deformities are acquired at any subsequent period of life.

Deformities occur, then, both as congenital and as non-congenital affections. Non-congenital deformities are, however, much more frequently met with than congenital deformities.

In these pages the subject will be treated in the following order, namely, in the first place an outline of the causes of congenital and non-congenital deformities will be given, and subsequently the various deformities of the human body will be considered in detail.

Many causes have been assigned by various authors for congenital deformities, such as malformations and displacements of various portions of the skeleton; affections of the muscular system; malposition *in utero;* arrest of development and disordered nervous influence; but those to which I will especially direct attention are, 1st, disordered nervous influence, and, 2ndly, arrest of development.

Disordered nervous influence.—Rudolphi* first showed that club-hand and club-foot in the fœtus arise alone through morbid nervous influence acting on the muscular system.

Spasmodic action from cerebro-spinal irritation is, doubtless, the most frequent cause of congenital deformities which depend on muscular action. This spasm may be clonic or it may be of a more

* 'Grundriss der Physiologie.'

NOTE.—The term Orthopædy is derived from ὀρθὸς, straight, and παιδίον, a child, and was introduced into the language of science by Andry. "From these two words I compose," he says, "the term *orthopædy*, to express in one word the design which I propose to myself, of inculcating the means of preventing and correcting in children the deformities of the body."*

* 'L'Orthopédie, ou l'Art de Prévenir et de Corriger dans les Enfans les Difformités du Corps,' par M. Andry, Conseiller du Roy, Lecteur et Professeur en Médecine au College Royal, Docteur Regent, et ancien Doyen de la Faculté de Médecine de Paris, tome i, p. 2, Préface, 1741.

permanent character. It is due to irritation. And whether this be occasioned by dentition, by intestinal worms, or other cause, it may give rise to club-foot, club-hand, wry-neck, squinting or other deformities. It was written by Marshall Hall, "Dentition, as I understand the term, begins at birth or even before. It is then that the tissues of the alveolar processes and cavities become the seat of augmented vascular action and nervous excitement, which do not cease until dentition is completed. I think it probable that many convulsive affections and their dire effects have their origin in utero: certainly many of the latter are congenital."

But spasmodic action, however excited, may be transitory: spasm may subside and a healthy condition may return. Under these circumstances the effects which are produced on the fœtus are less severe than when a similar spasmodic condition occurs after birth. It is not uncommon, however, that a partial recovery alone shall take place, and that the child shall continue subject to spasmodic movements, the limbs not being entirely under the control of the will. Should irritation be persistent, paralysis, together with degeneration of the affected muscles, may probably ensue.

Again, in the anencephalic fœtus every known form of distortion may exist, as well as luxations, whether complete or incomplete; and similar distortions are also met with together with hydrocephalus and hydrorachis. There is, in fact, no known form of distortion which does not occur with lesions such as these.

During fœtal life growth is remarkably rapid. But if during this period spasm should continue even for a comparatively short time, the affected muscles may remain more or less contracted while their antagonists become in an equal degree elongated and weakened: the growth of these muscles is not in proportion to the rest of the limb; and they are then said to have undergone *congenital structural shortening*.

Like other nervous affections congenital deformities are hereditary. Thus, I know five boys in one family who have suffered with congenital talipes varus, their father, uncle, and paternal grandfather having likewise suffered from similar forms of distortion. In each generation females were added to this family, but none of them were deformed at birth. I have lately also seen another family of four children, two boys and two girls, all of whom were club-footed at birth: their mother also was club-footed. But besides these cases, many others somewhat similar have come under my notice.

Dr. Little, speaking of talipes varus, says: "I have traced it on the paternal side even through four generations—namely, the male infant, the father, the grandfather, and the great-grandfather."*

Also certain contracted conditions of fingers and toes are not uncommonly found to belong to certain families—thus, the great toe in every member of one family with which I am acquainted is so contracted as to be drawn more or less across the other

* Article "Orthopædic Surgery," in 'Holmes' System of Surgery.'

toes; and this has occurred to my knowledge for three generations; but it is believed in the family to have been a peculiarity belonging to many previous generations. Also, in another family, contraction of the second toe belongs invariably to every member of the family. And so much is this the case that it is not known that any child has been born in this family for many generations without this contraction. They have in consequence a very peculiar gait, which is recognised in the family; and although it is far from being graceful, it is looked on with a certain amount of family pride and satisfaction: it is undoubtedly a distinction. In a similar manner one or more fingers may be contracted: the little finger is especially affected in this manner.

Arrest of development occasions deformity, or even monstrosity, when it occurs in a limb whilst growth elsewhere proceeds in a normal manner. Thus, if in the embryo growth be arrested, and this condition of parts be continued in the fœtus, monstrosity ensues. For instance, a hand without fingers, or a foot without toes, represents, according to Wagner, the conditions of those parts of the embryo at the seventh week of development. Should arrest of development take place in these parts at this period of existence, a form, which in the normal condition is transient only and confined to embryonic life, becomes, if continued, monstrosity in the child. Further, it has been shown by Wagner that up to the fourth or the fifth month, or even later, the embryo will present a club-footed appearance. But if at this period arrest of development should occur,

so that the muscles on the inner side of the limb (say the adductors of the foot) cease to be developed in proportion to the rest of the limb, the condition now alluded to—the normal condition of the feet at this period—necessarily remains, and, as regards the affected muscles, development at birth is imperfect, and the feet still continue, as in the embryo, clubbed.

It is believed by some that intra-uterine pressure is the cause of congenital deformities. It should be remembered, however, that at an early period of gestation the embryo floats in the liquor amnii, and that as utero-gestation advances, and the fœtus becomes bent upon itself, the fluid prevents injurious pressure of the uterus, and enables those movements to take place which, indeed, become stronger and more marked until the period of gestation is completed. I have made use of the term "pressure of the uterus," but it is misapplied; for in its passive state, and until labour commences, the uterus exercises no pressure on the fœtus, but yields to every movement from within; and it is only when this passive condition is exchanged for one of action, to expel its contents, that the uterus exercises direct pressure on the fœtus. It is, therefore, impossible that the uterus should produce such pressure upon the fœtus during gestation as to induce deformity.*

* Professor Louis Bauer says, truly enough that, if intra-uterine pressure were a cause of club-foot, every child should be club-footed, for the foot is naturally inverted *in utero*. ('Lectures on Orthopædic Surgery,' p. 49.)

The causes of non-congenital deformities are especially, as indeed has been already observed with regard to congenital deformities, various forms of disordered nervous influence. But there are also other causes such as local inflammation, debility and rickets; all of which are common causes of non-congenital deformities.

Disordered nervous influence.—During infancy spasmodic action is very frequently occasioned by dental and by intestinal irritation. Marshall Hall wrote:—"The age of convulsive diseases is specially that of dentition, and of what I may term dubious diet." Indeed, dental irritation is the most frequent cause of spasmodic action during infancy. But also, irritation of the sympathetic system of nerves, whether occasioned by errors of diet, by worms in the alimentary canal, by retained feculent matter, or by other like cause, often gives rise to spasm and convulsions. These forms of irritation are common during infancy, and they constitute at this period the most frequent causes of spasm and paralysis. Other causes of cerebral congestion and irritation of the spinal system of nerves exist, such as exposure to the sun's rays, the incubation of the exanthemata, a renal calculus, an insufficiently strangulated nævus; and, indeed, there is scarcely a condition of the body that can be named, apart from health, in which convulsions may not be induced. Carpo-pedal spasm may exist without cerebral disturbance; but when irritation is continued, convulsions follow, with perhaps, paralysis and death.

Spasmodic action is sometimes caused by pressure upon the head of the infant during birth. The

deformities which arise from this cause are doubtless frequently not distinguished from those which have been previously alluded to as congenital distortions; but tonic rigidity of a limb or of a pair of limbs (for the most part the lower limbs) or of the entire voluntary muscular system may result from some injury at birth, such as is sustained by the brain and the brain-case, or by the vertebræ and the spinal cord, through too much force in the application of instruments or, indeed, without instrumental interference, when undue violence is used. This may occur together with or even without deformity and contraction of the pelvis. In these cases the flexors and the adductors of the thighs, the flexors of the legs, and the extensors of the feet are for the most part affected. The upper limbs are usually less affected than the lower, yet the elbows will also probably be found partially flexed, the forearms pronated, and the fingers wanting in power. The muscles of the neck are also in these cases deficient in power, and unable to support the head; so that the head rolls from side to side, and falls on to the breast or backwards. In the same manner the muscles of the trunk participate in the general weakness, and the child is in consequence unable to sit upright. In children thus affected there is also occasional or constant strabismus, and the muscles of speech are also not unfrequently implicated: in some a cry only can be uttered, in others a syllable or two; while again in others, and this is more commonly observed, violent stuttering is provoked by a very slight amount of excitement. Thus, a single muscle or a group of muscles or the entire voluntary

muscular system may be affected, and endless varieties of deformity are in this manner produced.

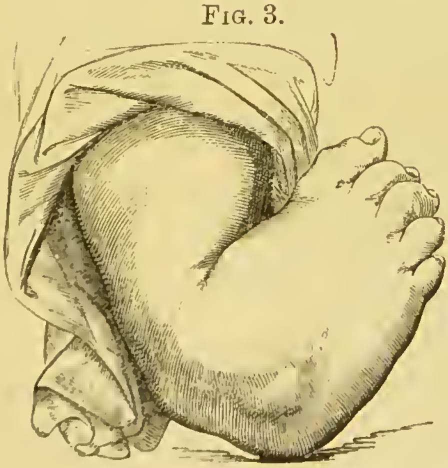
Such, then, are the forms in which spastic contractions are seen during infancy. And together with these spastic conditions of the arms and legs, there will probably also be found abnormal conditions of the feet and hands: indeed, every known form of talipes and cheirismus is to be found together with these rigid limbs.

The accompanying figures, 1, 2, 3, were taken from a case in which this condition had been developed.

Fig. 1.

Fig. 2.

Fig. 3.



When convulsive action has once been developed spastic contraction may ensue or a limb may be wholly or partially paralysed. The countenance of the child usually indicates the presence of cerebral disturbance : there is either absence of expression, the child remaining dull and listless or otherwise it is excited. These children are, however, frequently more intelligent than a casual observer might suppose. The memory is sometimes good and the brain is tolerably active (although the child is always more or less morbidly excitable), while the extremities—hands and feet—may be almost, if not quite, useless. The increase of intelligence and brightness of countenance is sometimes very remarkable, when a child having been placed in the position to do so commences to use its limbs. From being fretful and unhappy such children are now among the happiest, and need scarcely any other enjoyment than the pleasure of using their limbs.

Spasm of one limb and paralysis of the opposite limb is not unfrequently observed. Spasm is usually first developed in the upper, and later in the lower, extremities. It is often stated otherwise; but observation shows that in spasm the lower limb recovers power sooner than the upper: but that, when paralysed, the upper extremity usually first recovers power.

After a succession of slight convulsive attacks, certain muscles remain, perhaps, rigid; the most powerful being the most affected, or appearing to be most affected. Thus the thighs are more or less flexed and the knees are approximated, or even the legs are crossed one over the other and maintained

so firmly in this position that considerable force may be inadequate to separate them; the legs are flexed, and the feet are extended and inverted. Also, the arms are bound to the sides, the forearms are flexed, the hands are prone, and the fingers are flexed. Every form of squinting may be observed together with these rigid muscles. And, indeed, every voluntary muscle may be subject to this spasmodic action. As has already been said, this state of spastic rigidity may pass into paralysis.

There is a cast in the Hospital Museum, No. 72 c, Series 22, in the Catalogue, in which are represented almost every possible deformity to which spastic rigidity can give rise. Disease in the case from which this was taken was developed in infancy, and was continued, constantly increasing, until death took place, at twenty-five years of age. Here are seen talipes varus, talipes valgus, contractions of the knees, hips, elbows, wrists, fingers and toes, wry-neck, and lateral curvature of the spine.

Again, in the adult, affections of the sexual and of the urinary organs occasion disorders of the brain and spinal cord, and give rise to deformities. Thus it is not uncommon to see hysteria associated with spasmodic contractions.

In cases such as these there has possibly existed some congestion of the spinal cord, which, having subsided, has left the deformity as a local affection, dependent alone on structural shortening of the affected muscles.* Not only may a hand or a foot or an arm or a leg be thus affected, but one side of

* See Remarks by Dr Dick, 'Transactions of the Pathological Society of London,' vol. xv, p. 253.

the body or the entire muscular system may be involved in such cases as these.

Paralysis presents itself especially in three forms —namely, that which arises from organic change in the nervous centres; that which is known as myogenic paralysis, or the essential paralysis of infants; and paralysis from traumatic lesion of nerve-trunks.

Paralysis, whether hemiplegia or paraplegia, is observed at every age as a consequence of organic change. During infancy, paralysis not unfrequently occurs without evident cerebral disturbance, perhaps during sleep or while a child is at play; and it often occurs without previous indication to an ordinary observer, the child appearing to be in his usual state of health. The following cases will serve as illustrations. A child was playing in his father's garden, when suddenly he lost the power of his lower limbs: he was paraplegic. Another child was observed to squint: an epileptic seizure followed soon after, and this was succeeded by paralysis of both the upper and the lower extremities. A third child was convulsed, and remained unconscious for several hours: in this instance hemiplegia resulted. Now, whether deformity is occasioned by spasm or by paralysis there is a certain amount of resemblance in the resulting distortion. For instance, paralysis of the sterno-mastoid muscle will cause the muscle of the opposite side to contract upon itself and thus will draw the head down towards the shoulder of the same side, at the same time that the chin is rotated in the opposite direction. And spasmodic action of

the sterno-mastoid muscle also occasions a similar distortion. Again, when the muscles on the anterior surface of the leg become paralysed, such as the tibialis anticus and the extensor longus digitorum, their antagonists—namely the gastrocnemius and soleus, the tibialis posticus and flexor longus digitorum—gradually contract upon themselves, producing elevation of the heel with some inversion of the foot. And, as in the case to which I have already alluded, spasm of the extensors and of the adductors of the foot produces a similar form of distortion. From long continuance in a contracted position and a more or less unused condition of the muscles, structural shortening results; and ultimately fatty degeneration ensues, not of the paralysed muscles only, but also of those which are contracted.

In these cases of paralysis, a single muscle may alone be affected or a group of muscles or an entire limb may be deprived of power, or the power of one side may be lost, or both the upper and the lower extremities may be simultaneously paralysed. Florid children are, perhaps, scarcely less frequently the subjects of these attacks than those who are weak and ill-nourished.

Cerebral symptoms are, for the most part, preceded by spastic contractions. These premonitory symptoms—such for instance as squinting—are, however, frequently overlooked or their importance is not understood. The cause of irritation is consequently not recognised, and irreparable mischief, which might perhaps have been warded off, is allowed to occur.

Paralysis of one side of the trunk always gives rise to lateral curvature of the spine, the healthy muscles acting upon the vertebral column and drawing it away from the mesial line of the trunk. The length of the spinal curve will depend both on the extent and the degree of loss of muscular power: a single curve may be formed when paralysis is general on one side; but when it is confined to two or three muscles, the trapezius and the rhomboidei for instance, the curve will be compensated by a second curve. In the same manner, after amputation of the arm, the muscles of the shoulder becoming atrophic lose their power; whereupon those of the other shoulder, not being duly balanced, exercise undue influence on the spinal column and curve it in the direction of their combined forces.

Loss of the power of motion is, however, only one form of paralysis. Another and a somewhat more rare form is loss of sensation. This loss of sensation may occur in a patch of skin only or both lower extremities may be affected or it may be even more general. When loss of sensation is partial and incomplete and perhaps confined to the lower extremities walking is accomplished in a clumsy and awkward manner, with some support, such as a couple of sticks or an arm; but should such a patient close his eyes while standing, he would probably drop to the ground. The limbs cannot be guided without the help of the eye, and the ground is felt imperfectly and is not grasped, if one may say so, by the feet. This form of paralysis passes on rapidly; and in many instances proceeds to the extinction of sensation.

Infantile paralysis, or the essential paralysis of infants, or myogenic paralysis, is perhaps that form with which we are most concerned.

A child is observed perhaps to be feverish, and on the following morning, or in the course of twelve hours, febrile disturbance will have increased, and there will probably be superadded acute pain of one or more of the extremities, so that the child cannot bear the limbs to be touched. Then, after some few days, pain ceases, and the child begins again to move its limbs, but with difficulty, and without complete voluntary power: some of the muscles or perhaps one or more limbs, remain paralysed. The lower limbs are affected in this form of paralysis more frequently than the upper; and the extensors of the leg and the flexors and the abductors of the foot are affected more commonly than any other groups of muscles. But, in addition to these muscles of the lower extremities, the deltoid, the trapezius, and the rhomboids may be paralysed, as well, indeed, as the entire upper extremity. Sensation, however, is seldom impaired.

This form of paralysis for the most part occurs before the child is two years of age. It is caused by exposure to cold, the bed-clothes being thrown off during sleep, by sitting on a stone seat, or by other like cause. Although this form of paralysis is often preceded by febrile disturbance and local pain, it occurs perhaps even more frequently without pain, or with only slight pain. It may take place without appreciable nervous lesion; or, again, the spinal cord may be affected in its entire length, and the nerves

which are supplied to the paralysed muscles will then become atrophic.

When paralysis is recent, muscular power may, in a large number of instances, be restored by means of electricity, stimulation, and warmth; and even after the lapse of three or four years something may be done to improve the condition of the affected muscles, although it is scarcely possible that they should then regain their former power. Should paralysis continue, contraction of the opponent muscles takes place and deformity results.

Traumatic lesion of nerve-trunks is a rare cause of distortion. A nerve may be divided, and temporary paralysis will ensue. After a certain amount of time muscular power will be re-established. But when a portion of a nerve is removed, paralysis will probably be permanent. Thus, I have known talipes calcaneus to be produced by the removal of a portion of the internal popliteal nerve together with a tumour from the ham. Gunshot wounds also occasionally give rise to somewhat similar results. Such lesions are irremediable. Fortunately they occur but seldom.

Another and rare form of paralysis is that which has been described by Duchenne, under the head of *Paralysie musculaire pseudo-hypertrophique*, or *Paralysis with apparent muscular hypertrophy.*

Duchenne divides the course of this disease into three stages, namely, muscular weakness; muscular hypertrophy; and general paralysis.

The first stage usually, but not invariably, commences in early infancy, and may last for a variable time—months or years—and terminates in hyper-

trophy. It commences especially in the muscles of the calves of the legs, and extends to the gluteal and the lumbar regions. In the upper extremity the biceps is also sometimes affected. Muscular weakness is often very great during this stage of the disease; but in the third stage weakness increases considerably and becomes even more general, so that the upper extremities grow weaker and the hypertrophied muscles waste. The patient cannot now walk nor stand, but drags himself about by the arms. I lately saw three members of a family who were affected in this manner. They consisted of two boys and a girl. The disease commenced in the elder boy when he was six years of age, and proceeded rapidly, so that in the space of five years hypertrophy of the affected muscles had disappeared, and wasting was complete. He retained great power in the upper limbs, and could pull himself up a flight of twenty stairs without excessive labouring. In the other two children the disease commenced during the first year, and at six and eight respectively they showed considerable hypertrophy of the gastrocnemii and the glutei, with talipes equinus. Boys are more frequently affected than girls with this form of disease.

Besides the causes already mentioned, inflammation and debility are common sources of non-congenital deformities.

Inflammation.—In the entire category of deformities to which I shall have to draw attention, none are more painful to witness than those which result from a severe burn. The chin is bound

down perhaps upon the breast or, not unfrequently, destruction of the integument is so great that the lower lip may be drawn down and everted; so that the saliva cannot be retained. And the teeth being unsupported by the lip are forced outwards. The disfigurement which is thus produced is excessive. Such a case requires to be seen that the whole extent of the misfortune may be understood. Not only is the chin obliterated and the lower lip bound down and everted, but all the features are distorted, the eyelids are drawn down and the eyes are uncovered, and the head is immovably fixed, so that it can neither be raised nor rotated. Thus, where destruction of integument is considerable, especially from burns, much deformity is produced. The amount of contraction depends rather on the position of the injury than on the extent of the cicatrix. Burns about the neck produce perhaps the greatest amount of deformity; for contraction takes place with cicatrisation, and even after cicatrisation is complete. And although the face itself may not have been touched with fire, the mouth and eyelids being drawn down, the resulting deformity is very great. With the greatest care and attention, it is in many instances impossible to prevent deformity; yet something may always be done to prevent the terrible results to which allusion has now been made. When contraction takes place, the deformity may yet be remedied whilst the cicatrix is recent. There was lately a patient under my care, in the hospital, 60 years of age, who had been burnt extensively on the back and breast and in the axilla, and whose arm was bound down to her side by adhesions,

so that she had no power to move it from her side nor to raise her hand; but by gradual extension she not only entirely regained the use of her arm, but the web which had formed wholly disappeared.

Again, a chilblain, or an ulcer, in healing, may occasion adhesions to form, which restrict motion and produce deformity. The muscles of the calf of the leg are more frequently affected than any others in this manner. Incised and punctured wounds when they occasion suppurative inflammation, and gun-shot wounds through destruction of tissue, also give rise to various deformities. And I must mention the viper-bite, although we rarely see any ill effects produced by it in this country. A notable instance, however, lately came under my care in the hospital, in which the patient having been bitten by one of these creatures, suffered from inflammation in several joints; and ankylosis resulted. Contraction of the gastrocnemii also took place, which necessitated the subcutaneous section of the Achilles tendons.

Lately also, another case of a similar kind came under my notice. It occurred in the person of a medical friend who was bitten, while resident in the South of France, by a viper in the finger. Very rapidly inflammation extended up the arm, suppuration took place in the finger and in the palm, and ankylosis of the second joint of the finger resulted.

Rheumatic inflammation, especially of the structures in the sole of the foot and in the palm of the hand, is of every-day occurrence. The fingers are drawn down into the palm, and the palmar fascia becomes thickened and contracted. And in a

similar manner, although to a smaller extent, the plantar fascia also becomes affected. But, also, rheumatic and other forms of inflammation produce an extensive series of deformities through the disorganisations to which they give rise in the various articulations, occasioning permanent muscular contractions, with partial ankylosis or, on the other hand, bony ankylosis may result when disorganisation is complete. Complete ankylosis is, however, rare.

Debility is one of the most common causes of deformity which is met with in a crowded and poor population. Hence are produced flat-foot, knock-knee, and curvature of the spine. Those who are compelled to stand for many successive hours, as compositors, errand-boys, and waiters in taverns, are liable to contract this painful affection—flat-foot. The plantar ligaments become stretched, and yielding permit the arches of the feet to sink. And in a similar manner the internal lateral ligament of the knee-joint yields, while the outer ham-string becomes tense; and thus knock-knee results. Again, during convalescence, and whilst growth is rapid, lateral curvature of the spine occurs as a common affection. Thus a weakly child, if it be treated in the same manner as a stronger companion, will probably acquire some irregularity of form; but the particular kind of deformity will depend on the habits of the child. For instance, through standing or walking much, flat-foot may be induced. This is a very common affection among children. A sense of weakness in the limb is caused by the loss of the arch of the foot, and in consequence the child will

probably stand more on one foot than on the other. Knock-knee will then be superadded. And should this occur to a greater extent in one limb than in the other, the pelvis will of necessity become oblique. But an oblique pelvis must induce curvature of the spine. And thus from a common source several deformities are produced.

In infancy, posterior curvature of the spine is induced by debility. The muscles of the neck and back not having sufficient power to support the head and trunk, the head falls forward on to the breast, and the spine is curved forward in its entire length. Also in youth and in old age a stoop is induced by a similar cause.

The affections of the osseous system into which I have to inquire are rickets and scrofula.

Rickets.—In consequence of the derivation of the term rickets it is commonly supposed that this disease affects especially the vertebral column. It is an error, however, to suppose that rickets frequently affects the spine. Sir Benjamin Brodie, in his lectures on 'Curvatures of the Spine,' which were delivered in the theatre of St. George's Hospital, said, "It was the prevailing opinion formerly, and I believe that some hold the opinion still, that the common cause of a lateral curvature of the spine is a rickety condition of the bones. This view of the pathology of the disease is not confirmed by the specimens preserved in the museums of morbid anatomy; and no one who has seen much of these cases in the living person can doubt that the fact is otherwise. We are not, therefore, justified in regarding rickets

as the common, or even as a frequent, cause of spinal curvature; nevertheless, it is the cause of it in a few instances."

Rickets is seen not uncommonly at birth. Occasionally it occurs with some deficiency, as of one or more toes, with their corresponding metatarsal bones, or of fingers, with, perhaps, clefts through the palm to the carpus. Together with these abnormalities, partial displacement of an articular surface, as the knee, and talipes in some form, may perhaps exist. Also, in these cases of congenital rickets, it is not uncommon to find a peculiar and sharp projection of the tibia: so sharp, indeed, is the projection sometimes, that it appears almost as though the bone had been broken. There is also a corresponding indentation of the skin, as though it had been punctured. The softened bone is bent sharply,

Fig. 4.

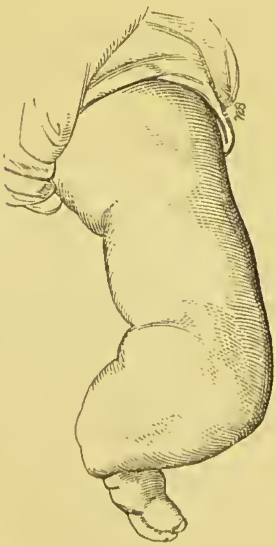


Fig. 5.

Fig. 6.

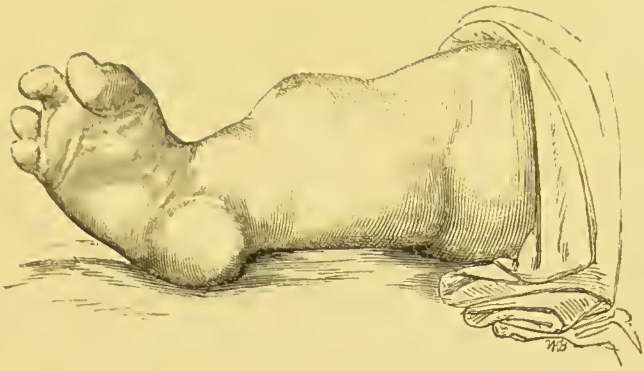
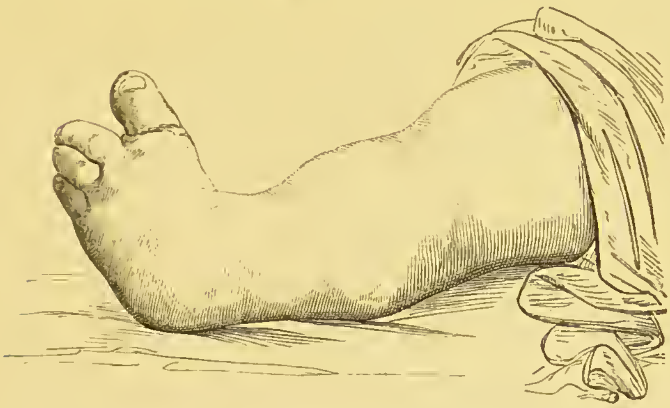


Fig. 7.



and the skin is thereby injured, and becomes more or less adherent to the periosteum. Figs. 4, 5, 6, 7, were taken from such a case.

Rickets is rarely developed in the infant while it is being suckled by its mother—that is to say, whilst it is well fed and warmly clothed; but when it is fed on vegetable and other indigestible matter disease begins to show itself. Rickets is a general disease, and not a disease of the skeleton only; and it abounds in all large and ill-fed communities: it is the result of poverty, bad food, and worse ventilation and drainage. Rickets is, for the most part, developed

between the sixth and the eighteenth month; and it is seldom known to commence after puberty. I have tabulated 500 cases of this disease, and find that female children are attacked considerably in excess of males, and also that in them the bones appear to be more extensively affected than in male children. Thus, of 28 cases of deformity of the pelvis, 2 only occurred in males. The following table shows, with sufficient accuracy, the periods at which rickets is seen to commence:

	CASES.	
At birth	26	
Between the second and the sixth month	16	
Between the sixth and the twelfth month	229	—271
In the course of the second year .	134	
,, ,, third year .	43	
,, ,, fourth year .	26	
,, ,, fifth year . .	15	
From the sixth to the twelfth year .	11	—229
		500

Of these cases 326 were females and 174 were males.

From this table it will be seen that a large majority of cases of rickets occurs before the first year is complete.

When the disease has shown itself early, the child is languid and unable to stand. He then moves about on the floor in a sitting posture, and bends the arm bones by leaning on them; and in crawling the leg bones are curved above the malleolus as he pushes himself along the floor, and this bowing

of the leg bones is increased when he is able to stand and bear the weight of the body upon his feet.

Scrofula.—In scrofula tuberculous matter is deposited in the medullary cavities and in the cancellous structure of the bones. The cancelli become dilated, and are filled with exudation, which eventually breaks down; abscess forms, and necrosis follows, with ulceration of the articular cartilages. In this disease the bones become soft and spongy; they are charged with oily matter, and are light in substance. Moreover, the blood-vessels are increased in size, so that when wounded, as occurs when portions of necrosed bone are removed, they bleed freely and often profusely. But, notwithstanding that a scrofulous bone becomes light and thin, and is deprived of some of its salts of lime, it never becomes curved, as in rickets. In these circumstances, the main distinctions between scrofula and rickets are to be found—namely, that in scrofula inflammation passes on to produce abscess, while in rickets abscess never occurs in the course of the disease; but curvature and deformity result. In the former caries of the spine, or angular curvature results; but in the latter scoliosis, or lateral curvature.

Having now drawn attention to the causes of congenital and of non-congenital deformities, I will proceed to consider in detail the various affections to which allusion has already been made; and will commence with the subject of Rickets.

CHAPTER II

RICKETS

Rickets is essentially a disease of infancy: it occurs not uncommonly at birth; but it is observed especially during the first and second years of life. This disease was not described until the middle of the seventeenth century, when Daniel Whistler selected the subject for his inaugural thesis, in 1645;* and Glisson, in 1651, made of it an elaborate study. At that time, as now, the affection was known by the name of rickets. It is probable that this term was formed either from the ancient French word *riquet* or from the German *rücken.*

Rickets is developed as a consequence of malnutrition. Hence it is that the disease is seldom seen whilst the child is being suckled at its mother's breast—that is to say, whilst it is kept warm and is well and sufficiently fed; but so soon as the food is insufficient or unsuitable, and the child is exposed to cold, then assimilation of food becomes imperfect, diarrhœa is frequent, the abdomen becomes tumid and night-sweats are observed, the child becomes weak and irritable, the muscles lose their consistence, and the skin acquires unusual sensitiveness. Then commence to be seen swellings of the ex-

* 'De Morbo Puerili Anglorum.'

tremities of the long bones and also those further changes in the various textures of the body combined with deformities of the skeleton which together constitute rickets. Thus, rickets is comparatively rarely developed until about the sixth month of infantile life. From this time and until the end of the second year more especially, those changes commence to take place through which are produced the deformities to which I shall allude.

Rickets is a general disease in which every tissue of the body is more or less involved; but the osseous system is more affected, or appears to be more affected, than any other tissue, in consequence of the deformities which are produced through the softening of the bones. Dr Little has well expressed it thus:—"Rachitis is not solely a disease of the osseous system, but its effects are in this part more obvious, and therefore have been longer noticed. My opinion is," continues Dr Little, "that every tissue of the frame is involved in the loss of tone and firmness —the bones, ligaments, the involuntary and voluntary muscles and their appendages, the membranes, and the glandular organs."* And Sir Wm. Jenner, in his admirable lectures, says: "In some books rickets is classed among diseases of the bones. This is a mistake. Rickets is no more a disease of the bones than is typhoid fever a disease of the intestines."† And he continues thus:—"Rickets being a general disease, the bones are affected as one organ, just as the arterial system is in the degeneration of age; the consequence of this is that no one bone is ever

* 'Lectures on the Deformities of the Human Frame,' p. 206, 1853.
† 'Medical Times and Gazette,' 1860.

affected without all suffering, and that whether the disease manifest itself chiefly by enlargement of the ends of the bones, or by softening of the bones, or by both in a proportionate degree." However well this opinion may satisfy the pathologist, it must be admitted that certain portions of the bony system appear to be affected sooner, and others later. Thus the enlargement of the wrist, which is always observed in rickets, is visible before any other affection of the bones is apparent. Rickets having commenced, doubtless disease proceeds to involve every tissue of the frame, if the conditions remain unfavorable to nutrition; but it is well known that this disease may be arrested, and that no further result shall appear than this swelling of the carpal extremity of the radius.

This swelling of the epiphyses of the radius and ulna may be considered to be characteristic of rickets. The malleoli and the knees also become swollen, though not so constantly as the wrist. I have seldom seen a case of rickets, however slight, in which the carpal extremity of the radius was not swollen. The bones throughout the skeleton become painful, and some of them are curved. Deformity takes place usually in the following order—namely, the tibia and fibula, the femur, the thorax, the clavicle, the spine, the radius and ulna, the humerus, the pelvis, and lastly the head and face. Guérin supposes that rickety deformity advances from below upwards; that the leg bones and the tarsal bones first show symptoms of disease, then the thigh bones and afterwards the pelvis and the spine—that a rickety spine necessarily involves rickety

deformity of the pelvis, thigh, leg, and tarsal bones.

As a rule, doubtless, the leg and thigh bones become curved sooner than the arm bones, in consequence of the weight of the body being thrown on to them, while the arms remain free. But this depends on the mode of progression. In the commencement of the disease the child may perhaps walk: he will then bend the tibia and fibula; and should he continue to walk, probably the femur also will yield. Then is produced what is termed *genu extrorsum.* But the disease may be developed before the child has begun to walk; and this is indeed common. Then he will push himself along, while sitting, with one or other foot; and in this way will bend the tibia more or less sharply above the malleolus, and perhaps the radius and ulna above the wrist. Or, again, the arm and thigh bones may be much curved, while the leg bones and those of the fore-arms remain straight. It is sufficient to see such a child move about upon the floor to understand how such deformity is produced: the child does not walk, and never has walked, but crawls about the room on its knees and supports itself on the elbows. Hence it is that in these cases the arm bones and the thigh bones are those only which are curved. And it is for the same reason that the leg and thigh bones are seen to be curved more frequently than other parts of the skeleton: because they have to bear the weight of the body. It frequently happens that after the leg and thigh bones have become somewhat curved they also become painful. It is in part because there is pain, and also

from a sense of weakness, that the child refuses to walk, and prefers to crawl about upon his knees and elbows or hands; and it is for this reason that the arms and forearms become curved as well as the lower extremities, as has been already explained.

The short bones become thickened in this affection, and, among others, the tarsal bones; the ligaments also are softened, and allow the arch of the foot to drop; and thus the superincumbent weight is transmitted especially to the inner edge of the foot. For the same reason the internal lateral ligament of the knee-joint has to bear a very unusual amount of downward pressure and in consequence yields, and thus a very common affection—*knock-knee*—is produced.

In rickets the entire organism is more or less affected: growth is arrested and development is impeded. But it is more especially with the bony structures that we are at present concerned, and in these the most striking lesions are the enlargements of the epiphyses of the long bones, the thickening of the flat and the short bones, the softening and the painful condition of the affected bones, and the deformities which result from mechanical causes.

Among the pathological changes which take place in the course of this affection are increased development of the spongy tissue of the epiphyses and of that portion of the cartilage in which calcareous matter is first deposited. Also the periosteum becomes thickened and vascular throughout the entire length of the bone, and especially at the extremities of the long bones—at the junction, namely, of the cartilage with the bone. The me-

dullary membrane becomes highly vascular, and a sanguinolent fluid occupies the medullary canal, the cancelli, and especially the epiphyses. The cells become distended, and are at length broken down, and the medullary cavities become chambers filled with bloody, pulpy matter, which will flow on cutting into the bone. The bones themselves become soft through diminution of their earthy salts, so that they readily bend, or even they may be cut with a knife. The salts of lime are taken up from originally well-constituted bones, and pass out of the system, especially in the urine ; and the bones, especially the shafts of the long bones, are rendered extremely sensitive, so that pressure cannot be borne. In some rare instances the progress of the disease is so rapid that all the bones may become softened in the course of some few weeks.

Such then are the conditions of the bones in rickets; and out of them arise such deformities as flat-foot, bow-leg, and knock-knee, as well as curvatures of the arm, forearm, and spine. But it must not be supposed that every case of flat-foot, bow-leg, and knock-knee results from rickets; for similar forms of deformity are produced by general and local weakness and through inability to sustain the weight of the body. In these, however, the characteristic mark of rickets—swelling of the epiphyses of the long bones—is absent.

When this disease is established in a long bone, the shaft yields to the superincumbent weight and becomes curved. This curve is an exaggeration of the normal curve of the bone; and consequently every rachitic curve which is thus produced has an

outward direction. But all rickety children are late in walking; and until they can walk, they push themselves along the floor in various ways; each thus determining by his mode of progression the position and the contour of the curve which is gradually formed. For instance, one will use the outer side of the foot and leg, with which to propel himself along the floor, and thus will curve the leg bones sharply above the outer malleolus; while another moving about upon the knees will curve the femur outwards; and, again, a third will rest on the elbow and work himself along with the hand; and thus will bend the humerus, and also the radius and ulna immediately above the wrist. The curves which are thus formed of the lower limbs are always considerably increased when the child begins to stand and walk.

Together with this weakness of the bones there is commonly associated corresponding weakness of the ligaments. The internal lateral ligament of the knee-joint yields, and the knee is inclined inwards, and thus is produced genu valgum, or knock-knee; or the femur and the tibia together being curved, there is produced genu extrorsum. Thus, there will, perhaps, be found knock-knee on one side, and bow-leg or genu extrorsum, on the other; or, on the other hand, the same kind of deformity may be developed in both extremities; and this is indeed generally the case, while the former is the exception. The leg bones are somewhat similarly bent in each limb; or the thigh bones are bent; or the thigh and leg bones are together bent; or the knees are inclined inwards.

When knock-knee exists, the weight of the body

is transmitted more and more towards the inner edge of the foot, so that at length the ligaments in the sole of the foot yield, and the arch of the foot sinks, until little or no arch remains. But it is also very common to find that in weak or rickety children the arch of the foot yields first and the knee later. The scaphoid and the cuneiform bones sink so as to lie upon the ground, and the consequent pressure of the soft structures in walking is painful, and causes an awkward and peculiar gait; the elasticity of the foot is destroyed, and its movements become much restricted; the abductors of the foot become retracted, and the foot is everted. Soon the ligaments of the ankle-joint yield, and there is often a greater sense of weakness about the ankle-joint even than in

Fig. 8.

the foot itself. Now, also, the internal lateral ligament of the knee becomes stretched, and the knee is inclined inwards, somewhat in proportion to the deformity which has been produced in the corresponding foot; and thus one knee may be more inverted than the other; as is shown in Fig. 8. When this occurs, the pelvis is rendered oblique, and curvature of the spine necessarily follows.

Treatment.—The treatment of rickets consists in the employment of all such measures as conduce to the restoration of health—namely, warm clothing, such as flannel next to the skin and enveloping the trunk and extremities; a diet composed mainly of animal substances, and a dry and pure air. Tepid bathing, cod-liver oil, and one or other of the various preparations of iron, are also useful. Constipation and diarrhœa, which so frequently alternate in this affection, are to be combated rather by a careful regimen than by the exhibition of drugs. It is rare, indeed, that strict attention to diet will not, at least in the commencement of rickets, be sufficient in itself to regulate the secretions and restore a state of healthy nutrition; but should it not be sufficient to effect this purpose, then recourse may be had to the nitro-muriatic acid bath, which, when used occasionally and as it may seem to be required, is of great value in these affections. This remedy is greatly to be preferred to the employment of purgatives and alteratives and the various preparations of mercury with which these conditions essential to rickets are yet treated by some.

The *surgical treatment* of the deformities which

are above described—namely, curvatures of the tibia and femur, and knock-knee—may be explained in very few words. It consists of the application of splints, or supports to the bent limbs. These are placed on the inner side of the curve, and pressure, by means of webbing bands, is thus readily applied to the outer side of the curve. In genu extrorsum, or outward inclination of the knee, the femur is curved outwardly as well as the tibia. In this deformity, therefore, the support should reach on the inner side of the curve to within two inches of the pubic bone. It should be made of metal, and as light as is compatible with the requisite strength, with a joint to correspond to the knee-joint, and its lower end should be inserted into a socket, which is let into the sole of the boot; while the upper portion is continued on the outer side from the knee to the hip, and is connected with a band which passes around the pelvis. Where the bones of the leg alone are curved the support should reach from the inner condyle of the femur to be let into the sole of the boot, as in the case before mentioned. In both cases a pad should be so placed as to correspond to the internal malleolus, so that pressure may not cause injury to the integument. It is easy in this manner to remove this outward curve of the leg-bones. But, together with an outward curve, there is not unfrequently found a forward curve also, and it is much more difficult to remove this anterior curve than it is to act on the outward curve. This anterior curve should be treated by means of a well-padded splint, and pressure should be made gradually, and increased very slowly; for in this

position, the bone being sharp, and lying immediately beneath the skin, pressure would readily cause a slough. To act on such a curve efficiently, pressure should be exerted only in the horizontal position, and the child should not be allowed to stand until the curve is removed. The same system is to be adopted in the application of splints to the humerus, and to the radius and ulna. In all these cases the apparatus should be provided with joints which correspond to the articulations of the limb, and which allow, consequently, of motion at the same time that such pressure as is necessary is applied to the curved bone. It is, of course, to be understood that this treatment, when applied to rickety bones, is to be used before nature's cure is effected; for as diarrhœa ceases together with night-sweats, and the functions of digestion are performed in a more healthy manner than heretofore, the epiphyses begin to diminish in size, and the salts of lime then are again deposited in the bones, so that they not only acquire their normal strength, but become endowed with much greater solidity and consistence than in their normal condition. The phosphate of lime is then deposited in abundance, especially on the inner side of the curve, and this deposit greatly increases the weight and strength of the bone. This is the cure which nature performs; and when this has been effected, the curves which exist remain unalterable.

Genu valgum, or knock-knee, requires support on the outer side of the limb. This support is, perhaps, best given by means of a metal stem, which is fitted above into a band which encircles the pelvis, and

below into the sole of the boot: joints correspond to the articulations of the limb, and one or more bands support the knee. In severe cases it is advantageous to attach a rack-and-pinion joint to such an instrument, that the direction of the stem may be altered as the limb yields. And where such an apparatus is necessary, the child should be kept in the horizontal posture. If exercise be allowed, it should be taken sparingly. In some severe instances of this deformity it is necessary to divide the hamstrings.

CHAPTER III

CONTRACTIONS OF THE LIMBS

Contractions of the limbs may be general, as is seen in spastic rigidity from spinal irritation; or a limb or a portion of a limb only may be affected, through injury to the nervous system or from local injury or as a result of inflammation. Thus, spasmodic contraction may affect an upper or a lower extremity, or a hand or a foot only, or the entire muscular system may be involved. The muscles which are most frequently affected in this manner are the flexors and the adductors of the thighs, the flexors of the legs, the extensors and the adductors of the feet, the flexors of the arm, and the flexors of the wrist. But, besides these, a spastic condition of the muscles of the head and trunk, those of the orbit and of the organs of speech and deglutition, occasioning wry-neck and every form of spinal curvature, squinting, stuttering, and difficulty in swallowing, is also met with, following those lesions to which allusion has already been made.

Again, paralysis gives rise to distortions which bear in outward form a close resemblance to those which have been occasioned by spasm. For, as in spasm the flexors, adductors, and pronators of the limbs are more especially affected, so in paralysis the

opposed sets of muscles, namely, the extensors, the abductors, and the supinators, become more especially implicated. And thus, for instance, the wrist may be flexed through spastic rigidity of the flexor muscles, or it may equally be flexed through paralysis of the extensor muscles and the consequent contraction of their opponents. And in the same manner the foot may be affected with talipes varus through spasm of the gastrocnemius and the adductors, or it may equally be distorted into talipes varus through paralysis of the muscles on the front of the leg and the abductors and the consequent retraction of their opponents. These morbid states, then—paralysis and spasm—are induced by irritation or by organic change in the nervous centres. The lesion may be congestion only, or effusion and softening may result.

But local inflammation is, perhaps, even a more common cause of contraction of limbs than nervous lesion. Inflammation of and around joints, whether it be in the form of rheumatism or scrofula, phlegmonous erysipelas or from mechanical injuries, gives rise to contraction of the limb, with more or less immobility.

I will now proceed to consider the various forms under which contractions of the limbs are met with, and will afterwards direct attention to the treatment of these results of spasm, paralysis, and inflammation, as they are brought before us in the deformities with which we have to deal. And because club-foot is of very frequent occurrence, and in the treatment of this deformity that of all other deformities may be said to be comprised, I will commence my descrip-

tion of contractions of the limbs with the description of talipes, or club-foot, and then continue to treat of the various contractions which are met with of the lower extremity.

But before entering on the description of these various forms of contractions of limbs, it may, perhaps, be well to devote a short space to the consideration of the re-union of tendons, seeing that these deformities are removed for the most part by division of one or more tendons in the commencement of the treatment.

SECTION AND RE-UNION OF TENDONS

At various times attempts have been made to remove deformities by the section of tendons. Thus, Thilenius, in the year 1784, divided the tendo Achillis, and Sartorius, in 1806, performed a similar operation. Michaelis followed in 1809, and operated on various occasions. He did not, however, cut the tendon across, as was done by Thilenius and Sartorius, but, having divided the tendon in part, he ruptured the remaining portion. Delpech, in 1816, next divided the Achilles tendon ; and he divided it subcutaneously. Delpech subsequently wrote the following rules for the section and re-union of tendons. They are admirable, and may be said still to be recognised as the rules for the subcutaneous division of tendons:

"1st. The tendon to be divided should not be exposed; but its section should be made by inserting the knife at a distance from the tendon, and not by making an incision in the skin parallel to it. There is danger of exfoliation of the tendon unless this precaution be taken.

"2nd. Immediately after division of the tendon, the divided extremities of the tendon should be brought into contact and so be held by a suitable apparatus, until re-union is accomplished.

"3rd. As re-union can only take place by an intermediate fibrous substance (*organisation inodulaire)*,

gradual and careful extension should be made, to give the required length to the shortened muscles, before solidification takes place.

"4th. Extension being complete, the limb should be fixed in this position, and be so retained until the new substance has acquired that firmness of which it is susceptible."*

The author of these rules may well be said to be the originator of subcutaneous tenotomy.

Fifteen years after the operation by Delpech, and three years after the publication of his work on the subject, Stromeyer first divided the tendo Achillis.

Stromeyer published his 'Contributions to Operative Orthopædic Surgery,'† in 1838, in which the following occur as his rules for the performance of subcutaneous operations :

"When it can be done, the tendons of the resisting muscles must be divided ; but when the tendons can be reached only with great difficulty, then the muscles themselves should be divided. The section should be made beneath the skin, when this is possible, and the skin itself should not be divided. Small instruments of different shapes are to be chosen for this purpose : generally, a moderately curved, sharp-pointed knife is the most useful. The limb should be so held that the tendon to be divided may be made to stand prominently forward ; and the knife being passed behind the tendon, and the point of the knife having reached the opposite side, the resisting tendon is to be divided rather by pressure against the edge of the knife, than by an onward movement of

* 'De l'Orthomorphie,' tome ii, p. 330, 1828.

† 'Beiträge zur Operativen Orthopädik,' Hannover, 1838.

the blade. The yielding skin follows on the blade of the knife, so that the two small wounds are only of the same breadth as the blade. I have very often divided the tendo Achillis with a single puncture of the skin; but this is unimportant, for the two small punctures heal as quickly as one only. Usually, a peculiar cracking noise is heard at the moment when the tendon is divided. Section of the tendon with the point of the knife is not always safe; partly, because the point is not sufficiently strong, but, also, because other structures may be wounded should the patient not remain quiet. Probe-pointed knives are quite useless. . . . . When there are many tendons to be divided the sections should, if possible, be made at the same time, for extension is then accomplished with greater facility than when the operation has to be repeated."*

Stromeyer thus established the division of tendons on a secure and permanent basis, and ensured its reception as a standard operation in the art of surgery.

In the year 1836 Dr Little, who from childhood had suffered from equino-varus, visited Stromeyer in Hanover, and was operated on by him. In his work† Dieffenbach gives an account of Dr Little's return to Berlin after he had been operated on by Stromeyer; in the following words:

"A month had elapsed," writes Dieffenbach, "since Dr Little had taken a letter from me to Dr Stromeyer, in Hanover, when suddenly my door was opened, and the individual who had left me a cripple,

* Op. cit., p. 18.

† 'Ueber die Durchschneidung der Sehnen und Muskeln,' 1841.

entered with a vigorous and rapid step.' I can scarcely tell which was greatest, my astonishment or my pleasure. I immediately examined his foot, and found the shape normal, the sole in contact with the ground, the arch of the foot diminished; the calf of the leg had begun to be developed, and the entire lower extremity had gained its normal length. A miracle could not have struck me more forcibly; and I confess I was never more taken by surprise in the whole course of my life at the successful result of a surgical operation than by this; and I esteemed Stromeyer, who had performed the operation, even more fortunate than Little, who had benefited by it."

Dr Little chose, as the subject of his inaugural dissertation, talipes varus;* and soon afterwards returning to London, commenced that career on which his fame rests, and established in this country, by his example and writings, orthopædic surgery.

In connection with the treatment of deformities, numerous experiments have been made on the tendons of animals, to determine the mode of re-union after division. Some of the earliest were made by von Ammon, who published an elaborate work† on the subject with highly coloured and overwrought plates, which, however, contained much excellent and truthful material. He was followed by Jules Guérin, Bouvier, Duval, Pirogoff, and others. Our own countryman, Herbert Mayo, had previously given the results of his experiments on animals. He did not operate, however, subcutane-

* 'Symbolæ ad Talipedem Varum Cognoscendum,' Berol., 1837.

† 'De Physiologia Tenotomiæ experimentis illustrata,' 1837.

ously. Sir James Paget subsequently recorded a series of subcutaneous sections of tendons; and his record,* which is very precise, is of much value. The microscopical characters relating to the reparative process are given in considerable detail, and his representations are truthful records of the anatomical appearances which are presented. The preparations may be seen in the museum at St Bartholomew's Hospital. Gerstäcker and Boner about the same time also recorded a series of experiments of a similar kind; and Thierfelder made a like series of experiments with most carefully detailed results, together with the microscopical appearances which were presented in thirteen instances, of the reparative process and of the structural changes which were observed between the first and the fifty-sixth day.

There were some points which had not been clearly made out in the sections which had already been made, and therefore I determined to repeat to a certain extent what had already been done, and to observe the results of division and the structural changes which take place during the process of re-union when the limb is placed under similar conditions to those which are observed in man. The results of my investigations were communicated to the Royal Society, together with the anatomical specimens themselves, as well as the drawings which were made from them.† The mode of conducting these investigations differed from that adopted by Paget, Thierfelder, and others, in this respect, that instead

* 'Lectures on Surgical Pathology,' vol. i, 1853.

† These, together with the communication itself, are in the archives of the Royal Society.

of allowing the animal to move about after the section of the tendon had been made, the limb was kept at rest. The results which were obtained were intended to show, in the first place, the manner in which immediate re-union of the divided tendon is effected; and secondly, how re-union takes place when gradual extension of the uniting medium is made. This mode of experimenting had not previously been adopted, and it had not been ascertained what was the condition of the new structure under these circumstances. Even in Sir James Paget's description an error, I venture to think, had crept in, to which I will call attention.

Mr W. Adams also made some sections of tendons about the same time. He followed the plan which had previously been adopted of dividing the tendon and allowing the animal immediately to move about. But the result of this mode of treatment is not satisfactory in its application to surgery. When this operation is performed in man, a splint is accurately bound to the limb, and the limb is held in the same position as before the operation for a certain period. In some of the experiments made by Mr Adams the new material was drawn out to a great length; and in consequence the uniting medium was unduly attenuated, and thus the muscle was deprived of power.*

* Mr Tamplin, referring to these experiments of Mr Adams, says, "Of necessity, the union was most imperfect, and no more illustrates the actual union of tendons, where proper precautions are used, than the false union of bone after fracture under similar circumstances would illustrate the normal union of fractured bone." ("A Course of Lectures on the Nature and Treatment of Deformities," 'British Medical Journal,' 1860.)

My experiments, I repeat, were made on the same principle as that on which the section of tendons is made for the removal of deformities in man, and the following details show the results. They were made on the Achilles tendons of twenty rabbits, and were divided into three series, to show—

1st. That when a tendon has been divided it may reunite without leaving a permanent cicatrix.

2nd. That the new material may be extended to any required length. When, however, the divided ends of the tendon are widely separated and kept apart, re-union will not take place.

3rd. That the new material does not impair the power of the muscle, except when it is so elongated as to prevent entirely or in part the action of the muscle.

RESULTS OF EXPERIMENTS

1. The tendon was divided one inch from its insertion. The limb was then extended so as to approximate the divided ends of the tendon, and it was so held until re-union and consolidation had taken place. Two months having elapsed, the tendon was removed. A cicatrix was not observable externally upon the tendon. On making a longitudinal section of the tendon, however, a cupped depression was seen where the tendon had been cut across. After a more considerable lapse of time, namely, from three to four months, this depression in the tendon was no longer to be found.

2. When gradual extension after section of the tendon was made, as is done in man for the removal of deformity, the new material was drawn out to any required length. During consolidation contraction of the new material was always found to take place to a greater or less extent; but when extension of the uniting medium has been made the new material remains as a permanent structure.

3. When the new material which is deposited between the divided extremities of the tendon is extended slowly and gradually it may equal in diameter and strength the original tendon, and under the microscope it will at length not be distinguishable from it. It differs, however, in colour from the original structure for, instead of the uniform arrangement of fibres and the pearly lustre of normal tendon, it presents a greyish, translucent appearance.

The process of reunion after the subcutaneous division of a tendon is as follows :

Immediately after the section of the tendon has been made, the muscle retracts, somewhat in proportion to the power of the muscle. Thus in the case of the tendo Achillis the upper portion of the tendon is retracted together with the muscle away from the wound, while the lower portion of the tendon remains opposite to the puncture. A clot or two of blood may be found in or about the sheath of the tendon, and especially in the immediate vicinity of the wound. The inflammatory product is usually of small amount, and the exudation ceases after twenty-four hours. The external puncture is closed by adhesion in from twelve to twenty-four hours.

I found on the second day a film of blood in the sheath of the tendon, and a small quantity of lymph attached to the divided ends. On the third day the space between the divided ends of the tendon was equal to from three fourths of an inch to one inch : the sheath was thickened and its vessels were injected ; soft greyish lymph was attached to both extremities of the tendon, but especially to the upper divided end. On the fourth day this constituted a soft bond of union between the divided ends of the tendon, and the lymph was more or less blotched with blood. On the sixth day the ends of the tendon were more closely approximated, the intervening substance not being more than half an inch in length : it was well defined, firm, and ruddy, being streaked with blood. At this time the uniting medium was distinctly fibrous. The ends of the tendon, especially the

upper end, were enveloped in this new material to the extent of one fourth of an inch; they were also somewhat swollen, softened, and succulent. Occasionally an elongated clot of blood was found imbedded in this new material as an accidental product, which did not, however, appreciably hinder the healing process. On the tenth day the uniting medium had contracted to one fourth of an inch in length: it was softer, paler, and thicker than the normal tendon, but it was not less well defined, and it was at this time capable of very considerable resistance. The Achilles tendon of a rabbit, for instance, supported a weight of eighty pounds.

The reparative process appears to proceed equally well whether the sheath of the tendon be entirely or in part only divided; yet the sheath is doubtless important in giving definition to the new product. In the experiments which I made, slight adhesions to the sheath were sometimes found to exist. In numerous instances, however, the tendon was free in its sheath. It was found that when the sheath was entirely divided it did not contract with the muscle, but it was always afterwards adherent. Each day adds to the strength and perfection of the intermediate substance.

If the limb be retained for a long period in a position to favour perfect reunion, contraction of the new material continues to take place until a bulbous enlargement alone marks the point of section. This, also, at length disappears, and no outward trace of the passage of the knife across the tendon itself remains. On making a longitudinal section of the tendon, however, a slight central de-

pression may be observed, which marks the point where the tendon was divided. This depression is at length also removed, so that the condition as it is described by Sir James Paget is obtained, namely, no trace of the division can be discerned even with microscopic aid. Such, then, is the mode in which reunion takes place when the limb has been kept perfectly at rest.*

* In reference to this subject Sir James Paget states that "Gradually perfecting itself, but with a rate of progress which becomes gradually less, the new tissue may become at last, in all appearance, identical with that of the original tendon. So it has happened in the valuable specimens presented to the museum of the college by Mr Tamplin, Nos. 358, 359, 360, in the museum. They are the Achilles tendon and the tendons of the anterior and posterior tibial muscles of a child nine months old, in whom, when it was five months old, all these tendons were divided for the cure of congenital varus. The child had perfect use of its feet after the operation, and when it died no trace of the division of any of the tendons could be discerned even with microscopic aid." ('Lectures on Surgical Pathology,' vol. i, p. 270.) This statement probably involves an error; for when a tendon has been divided and extension has been made, as for the removal of distortion, the new material becomes a permanent structure, and is scarcely distinguishable under the microscope from the original tendon, though it differs from it in colour and general appearance for a much longer period than four months.

Mr Adams refers to these specimens as follows:—"In the museum of the Royal College of Surgeons are the tendo Achillis and the anterior and posterior tibial tendons from a child, removed eighteen months after they had been divided for congenital varus, by Mr Tamplin; and in these specimens it is said that no trace of the division and reunion could be detected, either by the naked eye or by the microscope. In the catalogue of the museum the following description is given of these preparations:

"'The tendo Achillis, and the tendons of the anterior and posterior tibial muscles of a child nineteen months old. They were all divided by subcutaneous section, nearly eighteen months before death. No trace of the division is discernible in any of them; their outlines and surfaces are regular, and their texture is uniform; even with the microscope no part could be found different from the rest.'

When, however, extension has been made—as for the removal of distortion—or when the section of a tendon has been made and the limb has not been kept at rest, the new material becomes elongated, either according to the desire of the surgeon or, whilst in its soft extensible condition, through the unrestrained motions of the limbs.

Should, however, these movements be excessive, and especially if they occur soon after the division of the tendon, reunion may be wholly prevented.

While the new material remains soft and extensible it may be drawn out to any desired length, and thus it becomes a means of restoring the proportions of a limb when structural shortening has taken place. But that this new material may be formed of the required length and of equable dimensions it is essential that extension be made gradually. Otherwise reunion will probably be imperfect or even it may be prevented from taking place; or, again, the soft material may be drawn out to an inordinate length,

('Pathological Catalogue of the Museum of the Royal College of Surgeons,' vol. ii, Nos. 358, 359, and 360.)

"With regard to these last specimens, I have already stated that they were not examined, when recent, by a longitudinal section, the only method by which, at a late period, the difference between the old and new tendon can be recognised—the new tendon always preserving an appearance of greyish translucency, which contrasts with the opaque pearly lustre of the old tendon. I have also demonstrated the very close resemblance between the old and new tendon in microscopic characters, so that it cannot be said that the absence of new connective tissue in these specimens can be considered as proved. Moreover, sections of these tendons were made by Mr Quekett and myself, some time ago, and there appeared to me to be some indications of new tissue in the tendo Achillis, but the traces were obscure from the effect of spirit, so that it was impossible to give a positive opinion." ('Reparative Process, &c.,' p. 152.)

as when extension is made too rapidly through want of experience in the use of mechanical means. Thus, paralysis, or weakness of a previously healthy muscle will be induced. In man I have known the divided ends of the Achilles tendon to be so widely separated after section of the tendon that reunion was prevented : the sheath of the tendon became thickened, but talipes calcaneus resulted. And in the dog I have known the new material to be extended fully six inches, while in the rabbit it has been lengthened four inches.

Thus, it is shown that reunion may take place under favorable circumstances without leaving a permanent cicatrix; while, on the other hand, it may take place through the formation of new tissue, which under certain conditions will remain permanently as an additional structure.

This new material may be extended to the required length without impairing the strength of the tendon, if extension be made gradually and while the substance is still soft; but when extension is made too rapidly the new material will be lengthened inordinately and remain unfitted for the purposes of the muscle. It then becomes only a slender uniting medium, which by its length impairs the power of the muscle.

CHAPTER IV

TALIPES, OR CLUB-FOOT

Talipes occurs especially in four principal forms, or varieties, which are distinguished by the terms equinus, varus, valgus, and calcaneus. But besides these specific forms, where the foot is directed downwards, inwards, outwards, or upwards, compound varieties, or intermediate forms, are met with, such as equino-varus, equino-valgus, calcaneo-varus, and calcaneo-valgus. Each of these varieties of talipes may be either of congenital or of non-congenital origin ; and each form may depend on any one of the several causes already mentioned, such as spasm, paralysis, inflammation, &c.

TALIPES EQUINUS

Talipes equinus is more frequently met with than any other variety of talipes. It is essentially a non-congenital deformity; but it occurs also, though rarely, as a congenital affection.

Talipes equinus consists in the elevation of the heel through morbid contraction of the muscles of the calf of the leg, the foot being neither inverted nor everted. Where this distortion occurs as a con-

genital affection, the other foot may also be distorted; and probably the hands may also be affected. Thus, in one instance which came under my care, there was talipes varus of one foot and talipes equinus of the other, as well as club-hands; or, again, one foot may alone be affected, as in the case from which Fig. 9 was taken. But a most extraordinary

Fig. 9.

instance of this kind of deformity is one from which the following figures were taken, and which I saw with Mr Lattey.

In this instance the child was well formed with the exception of the right foot; but on this foot there were eight toes. It was a large, broad foot, fully extended, and nearly half as broad again as the other foot. A slight sulcus separated the heel into two equal parts, making two small heels. The most

singular circumstance, however, connected with this deformity was that two Achilles tendons were inserted into this conjoint heel, and that both were large, well-developed tendons. The tendons were placed so far apart that it was necessary to introduce the knife a second time to divide the two tendons. The accompanying woodcuts show the two aspects of the limb.

Fig. 10.

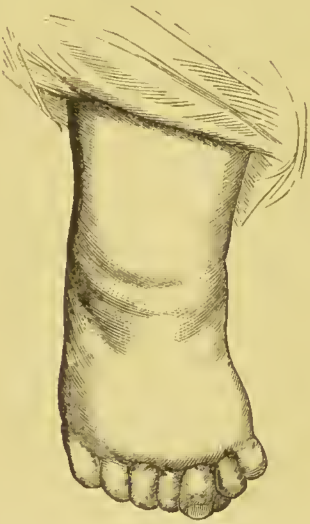


Fig. 11.

Although, then, talipes equinus occurs occasionally as a congenital affection, it is essentially known as a non-congenital deformity. The characters of the distortion are as follows :—The toes are pointed to the ground and the heel is raised, the muscles of the calf of the leg being retracted. The deformity varies in degree from inability to flex the foot beyond a right angle, to a vertical position of the foot, the

heads of the metatarsal bones and the phalanges supporting the superincumbent weight.

Thus, the extremities of the metatarsal bones and the toes resting on the ground support the weight of the body; and, in consequence, the metatarsal bones become slightly separated one from another, and the breadth of the anterior portion of the foot is increased. Fig. 12 is an example of severe talipes

Fig. 12.

equinus in advanced age. Here the separation of the phalanges may be observed.

When there is considerable loss of power in the muscles on the anterior surface of the leg, the foot may be retroverted, and even the entire dorsum of the foot may rest on the ground, as is represented in Fig. 13. Also I have known this retroverted form of equinus to occur in a case of congenital deformity. The case was under the care of Mr

Reeves. The child was four years of age, and both feet were affected in a similar manner to that represented in Fig. 13.

There is still another form of this variety of distortion, with very little deformity, however, which is notwithstanding occasionally, to say the least, extremely inconvenient, and which is known as rect-

Fig. 13.

angular contraction. In this condition, the foot cannot be raised beyond a right angle with the leg, and the anterior portion of the sole is pressed forcibly against the ground in walking. It is thus rendered tender and painful, and at length a callosity forms which induces lameness. Lately there was a patient in my ward in the Hospital in whom a large callosity on the anterior portion of the sole of each foot had formed in the manner now indicated. The patient was admitted with inflammation of the sole, and the callosity in each foot was in a sloughing condition.

When any lateral deviation of the foot is superadded to elevation of the heel, then other muscles

than those of the calf of the leg are called into action, such as the adductors or the abductors of the foot. Then we have a compound distortion produced, whether equino-varus or equino-valgus ; and the special form of distortion is determined by the relative power of one or other set of muscles, or it is determined by the mode of transmission of the superincumbent weight, or by some other such

Fig. 14.

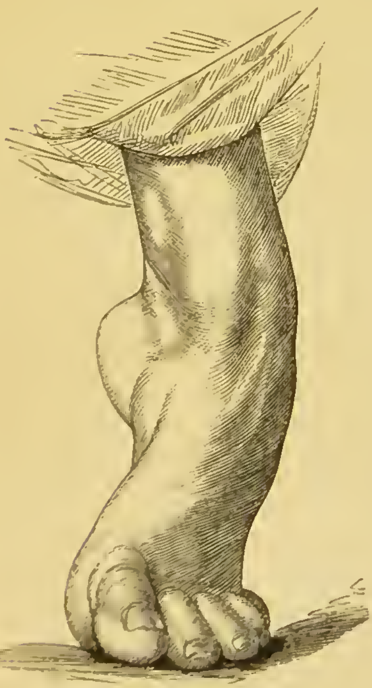


Fig. 15.

Fig. 16.

cause. Figs. 14 and 15 represent equino-varus, and Fig. 16 is an example of equino-valgus.

Fig. 15 represents equino-varus of paralytic origin; while Fig. 14 is taken from an instance of spasmodic distortion.

Pathological Anatomy.—In this deformity the bones of the foot are altered in position rather than in form. This would *à priori* be expected to be the case, since it occurs for the most part as a non-congenital distortion.

The tuberosity of the os calcis is raised, partly in proportion to the amount of contraction of the muscles of the calf of the leg, but partly also in relation to the loss of power in the flexor muscles of the foot; and this altered position is also in part influenced by the period of life at which deformity commences, the displacement being greater *cæteris paribus* when the deformity begins in early life.

An example of this distortion, the limb having been amputated, was sent to me by Mr Hester, of

Oxford. It was dissected and placed in the Museum of the College of Surgeons (Pathological Series, No. 9, B), and the preparation was described at length in the 'Transactions of the Pathological Society,' vol. x, p. 279. Distortion commenced in this instance during the earliest period of infancy, and it increased gradually until the foot assumed a vertical direction. The plantar surface of the foot became deeply arched and the tuberosity of the os calcis was raised, through contraction of the muscles of the calf of the leg, above its normal position; so that the upper edge of the tuberosity was raised three fourths of an inch above the extremity of the internal malleolus, and one inch above the tip of the external malleolus. These points are indicated by stars, and the relative positions of the bones are well shown in the accompanying plate, Fig. 17, which was taken from the dissected specimen.

Fig. 17.

An instance of so great deformity is not common; and in presenting it, therefore, I have been careful to state that it occurred in infancy and as a consequence of paralysis. The relative positions of the bones of the leg and foot are accurately given in the accompanying plate. But, although this deformity occurred in early infancy and as a result of paralysis,

there is not anything very remarkable in the amount of deformity, for on referring to Figs. 9, 12, 13, and 14, somewhat similar relations of the bones of the leg and foot may be observed. And, indeed, bearing in mind what has been above stated with regard to the age at which deformity commences and the amount of paralysis of the flexor muscles which may be present, somewhat similar positions of the various parts will always be found in this deformity.*

In consequence of the altered position of the os calcis, the tuberosity being raised by contraction of the muscles of the calf of the leg, the astragalus becomes forced forwards and downwards, and the head of the bone presents prominently beneath the skin on the dorsum of the foot. This is shown in Fig. 12. In extreme cases of vertical equinus ulceration of the superjacent skin even may be occasioned by pressure of the head of the astragalus, and this absolutely occurred in the case from which Fig. 12 was taken. Such a condition is, however, exceedingly rare, and it can only occur when the distortion is thus exaggerated, whereby the head of the astragalus becomes inordinately prominent.

The muscles undergo change, varying in every possible manner from a condition of health to that

* It has been stated by Mr W. Adams in reference to the position of the os calcis in equino-varus that "the os calcis is found, upon dissection, to deviate very slightly from its natural horizontal position," 'Transactions of the Pathological Society,' vol. viii, p. 396; and in his Jacksonian Essay 'On Club-Foot,' p. 83, he supports this position. I would refer those who are interested in this subject to the specimen above alluded to in the College Museum, the measurements from which were made by Professor Quekett and by Mr Murie.

in which entire destruction of their proper tissue takes place, and there is then substituted, for healthy muscular fibre, fatty and fibrous degeneration. These changes are most marked in cases of paralytic origin. In the instance above cited, and from which Fig. 17 was taken, all the muscles of the leg and foot were in an advanced stage of fatty degeneration: those situated on the anterior aspect of the leg were of a pale yellow and fawn colour, still, however, retaining the fasciculated appearance of muscle; while those in the posterior region were more agglutinated, and could scarcely be distinguished from a mass of fat. The tendons, also, were considerably diminished in volume.

The *extensor longus digitorum* was composed almost entirely of areolar tissue: degeneration of the muscular fibres was complete. No healthy muscular structure remained; but there was found a honeycombed structure of large fat-globules, the interstices being filled with innumerable granules and fatty matter.

In the *tibialis anticus* muscular transverse striæ were visible; but the greatest number of fibrils were filled with granular fatty molecules. The larger fibres broke into a series of squares, as though they were brittle. Between these, series of large fat-globules were seen. In the lowest part of the muscle, which was more yellow and fatty in external aspect, few fibres could be distinguished, and in these striæ were not visible. The mass consisted chiefly of a meshwork of areolar tissue and fatty matter with cells containing crystals of margaric acid.

Extensor proprius pollicis.—No muscular striæ were visible. The fibres were filled with oil-globules. There existed much areolar tissue and large fat-cells.

Gastrocnemius.—Muscular fibres were abundant, striated and healthy. The areolar tissue was in moderate quantity; and between the fibres, large fat-cells, containing crystals, existed. These were very abundant.

The *soleus*, as a mass, was like a lump of fat; yet here and there were portions of a deeper fawn colour. In these, healthy muscular fibres were seen in abundance, mingled with others containing molecules of fat. One or two fibres showed the commencement of breaking up into transverse laminæ, or as Mr Quekett describes it as "broken into short lengths." In some portions which were examined, there were not any large fat-globules present; in others of a yellower shade, but few muscular fibres were found, and these contained oil-molecules; but the mass chiefly consisted of areolar tissue and large fat-cells, many of which contained crystals of margaric acid.

In the *tibialis posticus* few or no muscular fibres were found, but areolar tissue, fat-cells (containing crystals of margaric acid), and no oil-globules.

The structure of the *flexor longus digitorum* was nearly similar to that of the last-described muscle: there were traces of muscular fibre, but the muscle was entirely changed into molecular fatty matter.

The outer aspect of the *flexor longus pollicis* was analogous to the preceding. One small patch of reddish muscle-like substance remained, which con-

sisted almost entirely of healthy striated muscular tissue. Some fibres were in the first stage of fatty degeneration : oil-globules were mingled among or between the fibres. In other portions of the muscle no striated fibres remained, and there was but slight appearance of muscular tissue, but areolar tissue and fat only. The few fibres which were found contained molecular fatty matter.

The *peroneus longus* consisted chiefly of fibrous areolar tissue, together with large-sized fat-cells, containing crystals and other fatty matter. The muscular fibres were as though converted into a granular membrane.

The *peroneus brevis* presented very few muscular fibres, and no striæ were visible. It was full of oily matter: large globules, containing crystals, were arranged in honeycomb form, together with other fatty elements floating about.

Also the bones of the foot were softened and fragile. A very thin layer of cartilage alone remained to cover the articular surface of the astragalus ; and the outer shell of the bone itself was no thicker than the cartilage, while the cancellous tissue was a mass of fat and oil, with some few spicules of bone interspersed.

Treatment.—The treatment of talipes equinus consists of the restoration of the shape of the foot after division of the tendo Achillis, by flexing the foot upon the leg. Occasionally the limb may be restored to its normal position and distortion may be removed by mechanical means alone, and without the use of the knife. This is especially the case

where distortion results either from paralysis or from spasm, and when it is slight and recent. When the distortion is severe, the tendo Achillis must be divided.

The tendo Achillis is usually divided from one inch to an inch and a half above its insertion. The tenotome should be passed beneath the tendon from the outer to the inner side of the foot; and the edge of the knife being then turned upwards towards the tendon, the knife will be drawn across it, making a clean transverse cut, the tendon at the same time being made tense. Care must be taken not to draw the knife through the skin covering the tendon. If too much force be used in extending the limb the divided ends of the tendon will be drawn asunder forcibly, and the integument will be drawn on to the operator's knife: it will then require some skill not to divide the covering skin. But, on the other hand, the limb may be so held that the tendon is left lax: it will then be difficult to divide the tendon.

Scarpa's shoe is the instrument ordinarily used in the treatment of this deformity. It may be applied so soon as the puncture has healed, on or about the fourth day; and extension may be carried on slowly and gradually, until it is complete in about six weeks. Should extension not be sufficiently rapid, at the end of six weeks distortion will only be in part removed; but, on the other hand, should extension be made too rapidly or forcibly, the uniting medium may be drawn out so as to destroy the power of the gastrocnemius, and calcaneus will then result.

The restoration of function is scarcely less important than the restoration of position in cases of deformity which come under treatment. It is a mistake to suppose that it is only required to remove an inconvenient position of a limb. Until power to use the limb as nature intended is in some measure restored, only small benefit is conferred by the restoration of a normal position. Electricity, shampooing, and baths, as they may seem necessary, are to be recommended in these and similar cases of deformity, and their use is to be continued until such power as can be regained is restored.

CHAPTER V

TALIPES VARUS

It has already been stated that varus, as well as every other form of talipes, occurs both as a congenital and as a non-congenital affection; but as it was shown that equinus is essentially a non-congenital distortion, so it must be now said that varus is especially that form of talipes which is most commonly met with at birth. In congenital varus one or both feet may be distorted. It is, however, somewhat more usual to find both feet affected rather than one only. Where only one foot is distorted, the right appears to suffer twice as often as the left, and the male child is affected with congenital talipes three times more frequently than the female. In a report which was lately made to the French Government it was stated that nearly 13,000 cases of talipes existed in France. It is probable that in this country the number of cases from every cause is relatively larger even than in France.

In talipes varus the foot undergoes a threefold alteration in its position in relation to the leg, as was first clearly pointed out by Dr Little—namely, extension, rotation, and adduction. The essential external character of varus, however, is, as its name

implies, inversion of the foot; and this may exist, though it is rare, without extension or rotation.

In congenital varus, as it is ordinarily seen, the heel is raised (extension), the toes are directed

FIG. 18.

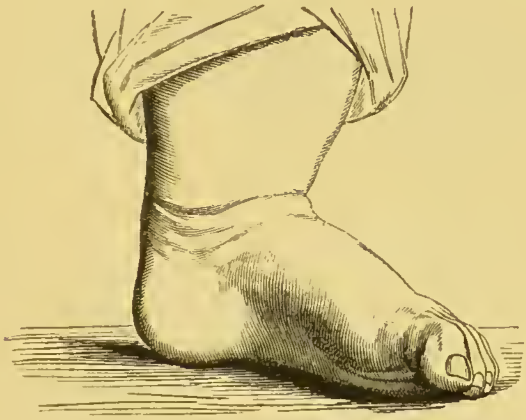


FIG. 19.

inwards (inversion), and the inner margin of the foot is raised (rotation). But although this, as it is now described, may be looked upon as the type of talipes varus, several degrees of distortion occur, which are described in treatises on the subject as grades. Thus,

there may be retraction of the tibialis anticus muscle alone, producing slight inversion of the anterior portion of the foot; and to this may be added contraction

FIG. 20.

FIG. 21.

of the plantar fascia, through which the length of the foot is diminished, as is seen in Figs. 18 and 19. Or again, the inner edge of the food is slightly raised, the toes are inverted, and the heel is elevated. This grade of distortion depends on retraction of the gastrocnemius and of the tibialis anticus and posticus muscles, as is shown in Figs. 20 and 21. The third grade is that which has been already described as the ordinary form of congenital varus. It is shown

Fig. 22.

in Fig. 22; while the fourth grade is the most exaggerated form of varus that is met with. In this form the inner margin of the foot lies in contact with the inner side of the leg, and the toes present directly upwards or are bent backwards; the heel is drawn up, and the dorsum of the foot is directed downwards and forwards, as is represented in Fig. 23. In this grade of varus the tendo Achillis appears to be deflected from its ordinary position and lies, in some

of these instances of severe distortion, immediately over the posterior tibial vessels ; the plantar fascia is shortened, and the muscles in the sole of the foot, as well as the extensors and the adductors of the foot and the flexors of the toes, are rigidly contracted. The muscles, then, which are principally concerned in producing this affection are those of the calf of

Fig. 23.

the leg and the tibial muscles ; while, on the other hand, the extensor longus digitorum and the peronei become weak and attenuated.

In a severe case of talipes varus some rotation of the tarsal bones is found to exist at birth. This rotation is easily overcome, however, and the foot is restored to its normal shape by careful and gentle treatment. Together with excessive distortion some

malformation of the tarsal bones may be found, which may offer serious and even insuperable impediments to the complete removal of deformity. These, however, are rare and exceptional cases.

When the weight of the body begins to be borne on the foot, as in walking, important changes commence to take place; for then the superincumbent weight is transmitted, not through the arch of the foot, as in the normal position of the limb, but it is received on the outer margin of the foot. In time the metatarsal bones, from want of adequate support, become folded, or doubled into the sole of the foot, and thus a broader surface is gained on which to rest; and a soft cushion, composed of fat and cellular tissue, is developed, which enables the weight to be more easily borne. This cushion or pad is often so large and perfect that it forms an excellent rest, and it enables the body to be borne almost as easily as in the normal position of the foot. It is, therefore, of great importance to any one afflicted with varus. In non-congenital varus this cushion is never well developed, and walking is therefore always more or less painful. Both in congenital and in non-congenital varus it inflames readily through over-walking or through exposure to cold: it will then probably slough. It disappears entirely after the deformity has been removed, and when the sole, instead of the outer margin of the foot, is placed in contact with the ground: its function has then ceased, and it, in consequence, ceases to exist.

Not only may the fifth metatarsal bone be doubled into the sole, but the fourth also becomes folded in with it; so that at length the weight of the body is

no longer transmitted to the outer margin, but it is borne on the dorsum of the foot. (These appearances are well shown in Figs. 24 and 25.) But

Fig. 24.

Fig. 25.

sometimes rotation of the foot is so complete that the weight of the body is thrown mainly on to the astragalus in walking; as is shown in Figs. 26 and 27.

In the adult, every structure entering into the

formation of the limb may undergo degeneration. The bones of the leg and foot become light and their walls become thin, and the tarsal bones are some-

Fig. 26.

Fig. 27.

what altered in form, especially the astragalus and the cuboid bone. The muscles also become atrophied through inaction; and after the limb is

restored to its normal shape they remain small; but their functions are in great measure restored. If, however, motion be not restored as well as the normal position of the limb, fatty degeneration of the muscles ensues.

I have already alluded to an old-standing case (of fifty years) of equino-varus at p. 60, and have described the pathological changes which take place. I have also stated that these changes in the structures occur more readily and earlier in non-congenital than in congenital varus. Indeed, in non-congenital varus or equino-varus of forty years' standing, muscular degeneration will probably be found already far advanced, and at fifty, as in the case to which I have referred, there may remain scarcely a trace of muscular fibre.

NON-CONGENITAL TALIPES VARUS

Non-congenital talipes varus may readily be distinguished from congenital varus, for there is present either spasm or, on the other hand, paralysis (see Fig. 28), or, again, the distortion may have been induced by loss of substance, such as is occasioned by a burn or, as in the case from which Fig. 29 was taken, by a lacerated wound. There may, therefore, be either more or less rigidity than is found in congenital varus, or there may be cicatrices, which invariably make the treatment of the case more difficult and eventually less satisfactory. Under these circumstances the general

outline of the limb is less regular, and the temperature is ill-maintained. The limb is in consequence

Fig. 28.

Fig. 29.

liable to inflame and ulcerate; yet, as would be supposed, the outward appearance of the distortion resembles somewhat that which is observed in a

like deformity at birth. This is always a painful distortion, for the callosity is ill developed; and, through undue pressure or cold, sores are liable to form. Such limbs are occasionally amputated, in consequence of the troublesome sores which are not unfrequently produced.

Treatment.—The treatment of varus should commence within some few weeks of birth. Nothing is gained by delaying the operation; but, on the contrary, through delay more time is required to produce an equally successful result. From one to two months after birth is the time which should be selected for the operation.

In very slight cases the distortion may be removed by bandaging together with passive movements of the limb: such treatment occupies a very long time, however, and is for the most part unsatisfactory. In an ordinary case of varus distortion cannot be removed by such means. With regard to mechanical treatment, Phillips says: "In the first degree of varus in infants, the foot may be restored without the division of tendons, and through the use of an instrument for extension only; but such treatment is both difficult of execution and occupies much time, it is often painful, and it is rarely efficacious. In every case, even the most simple, it is better to divide the tendons."

I entirely agree with the last-mentioned author, and believe that in every case the result is more perfect after division of the tendons and when gradual extension is made than when manipulation and extension are alone relied upon to remove

deformity. And not only is the result more perfect, but it is infinitely more easily and more rapidly effected than by manipulation only.

The tendons which require to be divided in talipes varus are those of the tibialis posticus and the tibialis anticus muscles, and the tendo Achillis. Varus is a compound distortion, and its removal should therefore be effected by various stages. Thus, inversion of the foot should first be overcome, the tendons of the tibial muscles having been divided: the distortion is thus reduced to the condition of equinus. In infantile varus the plantar fascia is seldom contracted or it is seldom so much contracted as to require division. When, however, the fascia must be divided, this should be done before the section of the tendo Achillis is effected.

In dividing the tendon to be operated on, the knife should first be passed well beneath it; and then the cutting edge being turned towards the tendon, this will be divided transversely on extending the limb. Some operators cut down upon the tendon instead of cutting upwards, or towards the surface, believing this to be the simpler method. It is a mistaken notion, however, for not only is the mode which I have indicated easier to perform, but effusion of blood is spared by adopting it. If not always entirely bloodless, this operation is for the most part so; but it is difficult to avoid wounding vessels when the knife is used to cut down upon a tendon, and frequently under these circumstances the effusion of blood is not inconsiderable.

To divide the tendon of the tibialis posticus muscle, the tenotome should be passed down to the

edge of the tibia, at from three quarters of an inch to one inch above the malleolus; and the sheath of the tendon may there be opened freely, without enlarging the external puncture. The rounded knife may then be passed into the wound, and, guided by the edge of the bone, be directed beneath the tendon. In the adult the tendon, being prominent and easily felt, may be divided with the sharp-pointed knife immediately after the sheath has been opened; but in infants it is safer not to use a pointed knife for the division of the tendon.

The anterior tibial tendon should be divided immediately after the posterior tibial has been divided. The knife should be passed beneath the tendon from without inwards as it passes over the ankle-joint, and the puncture should be made close to the tendon, so that the artery may not be divided. Occasionally, the anterior tibial is more tensely contracted than the posterior tibial tendon; in which case it should be first divided.

It is of real importance that the tendons now mentioned—namely, the tibial tendons and the tendo Achillis—should be completely divided, so that the restoration of the shape of the foot should proceed without hindrance. Should the tendon be transfixed, and consequently only in part divided, the treatment would be rendered, in at least a large number of cases, nugatory.

The division of the tendo Achillis has already been spoken of; and it is, therefore, unnecessary again to allude to it. Before, however, this tendon is divided, the inversion of the foot must be overcome.

After a tendon has been divided subcutaneously, the puncture is immediately to be closed with a morsel of lint, and the limb, having been bandaged, is to be bound to a well-padded, flexible metallic splint. It is a rule, which should always be observed, to place the limb, after division of the tendons, in the same position as before the operation; consequently, the splint is to be bent to the angle which the distortion represented, and bound to the inner side of the foot. When the punctures have healed —on the third or fourth day—the splint is to be removed, and one similar in kind, but longer, is to be applied on the outer side of the leg and foot. Even though a slight degree of traction alone be employed, it will be found that in the course of three days the foot will have yielded more, perhaps, than could have been expected from the amount of tension which may have been exerted. On replacing the splint a similar effect at a similar interval will be produced, until at length the foot is fully everted.

But, if in the infant it is important to deal with talipes varus as a compound distortion and to divide the treatment into stages, it is of much more importance to do this when the patient is older; for then, should the Achilles tendon be divided before inversion of the foot is removed, it may be impossible to bring the tarsal bones into their normal positions, and to unfold the longitudinal and transverse arches of the foot. It is therefore the rule not to divide the tendo Achillis, whether in infantile or in adult varus, until the foot has been fully everted. Although rotation of the anterior portion of the foot may only be slight, yet it may be difficult to overcome, and

even it may be impossible to replace the bones in their normal positions, should the fixedness of the os calcis be destroyed by the previous division of the tendo Achillis.

A straight, well-padded splint, carried to the knee on the outer side of the leg, and extending beyond the foot, is sufficient to remove inversion in a large number of instances of varus; but it is obvious that such an instrument is but ill-adapted to its purpose, and in severe deformity it is entirely inefficient. The instrument to be employed in this as in every case of distortion should be constructed in accordance with the mechanical relations of the parts to which it is to be applied, and the centres of motion should correspond as nearly as possible with the centre of motion of the articulation to be acted on. Scarpa's shoe clearly does not fulfil this desideratum ; but a modification of it, which is now in general use and is made by all instrument-makers, fulfils this purpose.

The plantar fascia, when contracted, should be divided before the support of the Achilles tendon is removed from the os calcis, whether in infantile or in adult varus ; otherwise the longitudinal arch of the foot cannot be fully expanded. It is rare, however, that this fascia requires to be divided in the infant ; yet occasionally the central portion of the fascia may require division, or the inner band of fascia may alone be contracted. In either case the contracted portions should be fully divided. In the adult the plantar fascia offers a serious impediment to the restoration of the shape of the foot, and requires to be freely divided.

When distortion has been removed, active and passive exercises of the limb, together with friction, galvanism, bathing, and other like means, must be employed, until easy if not complete power of motion is gained; for if the shape of the foot alone is restored, and the power to move it is overlooked, the patient will walk, but without elasticity and without motion at the ankle-joint; and then contraction, to a slight extent at least, will recur, and the tendons will again require to be divided. Thus it is that the treatment of talipes varus consists, in the first place, of the removal of distortion; and secondly, of the restoration of the functions of the limb.

CHAPTER VI

TALIPES VALGUS

TALIPES VALGUS occurs very frequently as a non-congenital affection, but more rarely as a congenital deformity. Its external characters are expressed in the name by which it is known, and which signifies that the foot is twisted outwards. The outer margin of the foot is raised, while the inner edge rests on the ground. The foot is flattened, its arches being more or less obliterated, and it is everted. Thus, talipes valgus is in some sort the reverse of talipes varus.

The accompanying figure (Fig. 30) represents a

FIG. 30.

somewhat severe form of congenital valgus. Some of the bones deviate from their normal positions—as, for instance, the os calcis, which in such a case is drawn upwards by the violent retraction of the muscles of the calf of the leg; and in proportion as the tuber calcis is raised, so is the astragalus extruded from beneath the tibia. But the foot is also abducted; and therefore there must be a certain amount of rotation of the scaphoid and of the cuboid bones, which in severe distortion always exists. This is produced by the action of the peronei. Even in such a case as that represented in Fig. 30 there is seldom found any deformity of the tarsal bones. Again, the foot becomes flexed upon the leg, and the anterior portion of the foot is raised, as well as everted, through the action of the extensor longus digitorum, as is represented in Fig. 31. Thus, there

Fig. 31.

is abduction, rotation, and flexion of the foot; and, in addition, the os calcis is elevated.

NON-CONGENITAL TALIPES VALGUS

In non-congenital as in congenital valgus the longitudinal and the transverse arches of the foot are obliterated, so that the sole of the foot rests with its inner margin flat on the ground. At first this flattening is only observed when the weight of the body is borne on the feet, as in standing; and on removing the superincumbent weight, the natural arches are, at least in part, restored. At length, however, the elasticity of the structures is lost, and the foot remains flat. This condition is very frequently met with in young and delicate persons with lax fibre. The tarsal ligaments in the sole of the foot yield and become elongated; and, especially under certain conditions, the deformity may increase so much as to produce a convex surface towards the ground—reversing, in fact, the natural arches of the foot. This is especially the case where much standing is required; and thus it is that certain trades are more prone than others to this flattened state of the feet. Figs. 32 and 33 are illustrations of more or less severe forms of non-congenital talipes valgus.

Talipes valgus also results from paralysis, the tibial muscles, one or both, having lost power. This occurs especially as a sequel of infantile paralysis.

Spasmodic valgus is comparatively rare. It remains as a sequel after convulsive action, which may

have been excited in childhood through dental or other irritation ; just as equinus may remain or varus

Fig. 32.

Fig. 33.

or strabismus, or indeed in the same manner as any other group of muscles may remain affected. In this class of cases the deformity is for the most part

very severe: the arches of the feet are reversed, and the sole is convex towards the ground.

Traumatic valgus.—The worst form of traumatic valgus that I remember to have witnessed came under my care in the hospital. It occurred after extensive ulceration on the dorsum of the foot, resulting from a burn. As cicatrisation in healing took place, the deformity was produced. The illustrations (Figs. 34 and 35) represent well the case to

FIG. 34.

which reference is made, and show how completely the arches of the foot were reversed, and how the foot was flexed and everted. The outer margin of the foot also was raised, and the tendo Achillis was tense; so that there was scarcely perceptible motion at the ankle-joint.

Again, valgus results from disease of the ankle-joint itself. It is not common, however, and when it occurs the lesser affection is lost in the greater.

No one would treat eversion of the foot, when there exists at the same time disease of the ankle-joint; except in so much that it might, and probably would, be necessary to support the foot on account of the disease in the articulation. Malposition, consequent upon disease, may, however, require to be removed: the peronei muscles may remain retracted, and the foot will in consequence be everted; or there may be, in addition, partial ankylosis of the ankle-joint.

And, lastly, inflammation about the foot and

FIG. 35.

ankle, by inducing softening of the ligaments, or through suppuration and loss of substance, may give rise to a form of valgus which is obstinate and exceedingly difficult to treat.

Treatment.—The treatment of congenital talipes valgus varies as the amount of deformity varies. Thus, slight cases of valgus are occasionally met

with, just as slight cases of inversion of the foot are also sometimes seen, which require no other treatment than the application of a bandage and splint, to bring the foot gently into its normal position.

When the tendons are rigid—indeed, in all severe cases of congenital and of non-congenital valgus—it is necessary to divide the retracted tendons. Whenever tenotomy is necessary in valgus, the peronei tendons must be divided. In a somewhat increased grade of distortion section of the extensor longus digitorum tendon will also be required. Eversion is then to be slowly and gently, but entirely overcome, and when the gastrocnemius is tense, the tendo Achillis should be divided and the foot be gradually flexed upon the leg until the natural position of the limb is restored. The peronei tendons may be divided at a distance of one inch above the external malleolus, and those of the extensor longus and peroneus tertius as they pass over the tibio-tarsal joint.

The *treatment of non-congenital valgus* varies according to the degree of deformity and also as the cause which gave rise to deformity varies.

A large majority of cases of valgus depend on general and local debility; and in these the form of the foot is restored by local support and by rest of the limb when deformity is slight. In such cases the general health requires attention; for such patients are overworked and under-fed, or they are wrongly fed, or they have outgrown their strength. For young people with lax fibre, a well-made boot with a spring in the sole, is all

the local treatment that is necessary; but, when deformity is of long standing, and structural shortening has taken place, it will be necessary to divide the peronei tendons, as well, perhaps, as the tendo Achillis. In paralytic valgus it is seldom necessary to divide tendons, except it be, perhaps, the tendo Achillis. And it is never necessary in rachitic valgus to divide any tendons. In rachitic valgus the tarsal bones undergo some change in form. The treatment in these cases is that which has already been recommended as the treatment of rickets, with that for talipes valgus superadded.

Spasmodic valgus being, as has been already explained, a sequel of convulsive action, it is necessary, after the subsidence of irritation and when the epileptiform condition, or analogous state, has been removed, to divide the retracted tendons and restore the shape of the limb. There is often superadded contraction of other muscles than those of the foot only, the upper extremity frequently being also affected as well as the muscles of the thigh (especially those of the internal and of the posterior femoral regions); but in the foot it becomes necessary to divide the extensor longus digitorum, in addition to those other tendons which have been already mentioned.

The mechanical treatment of this, as of every other deformity, should be carried on gently and without violence, so that the integument may not be injured. It is often tedious. Force, however, is never necessary; for the structures will yield to the continued extension of a well-adjusted instrument.

Allusion has been made above to a compound

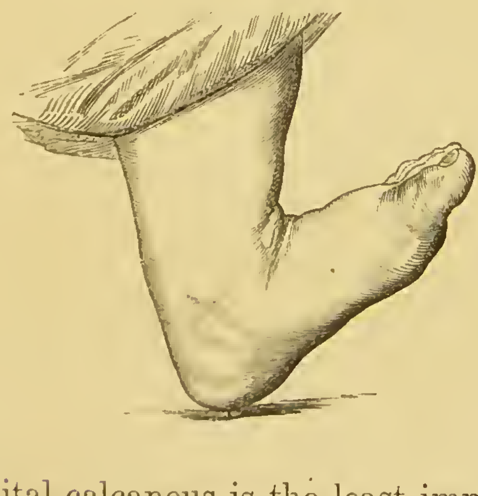
variety of talipes valgus, which is known as *equino-valgus.* This term is applied where there is somewhat more elevation of the heel, through contraction of the muscles of the calf of the leg, than is found to exist in an ordinary case of valgus. In every other respect the distortion is similar to that which has just been considered. It is unnecessary, therefore, to make separate mention of this variety; but, without this explanation, some confusion might arise on account of the nomenclature.

CHAPTER VII

TALIPES CALCANEUS

The essential characteristic of talipes calcaneus, whether congenital or non-congenital, is depression of the heel. In congenital calcaneus the dorsum of the foot is brought more or less into contact with the anterior surface of the leg; and it is retained in this position by retraction of the flexor muscles of the foot. In this respect, therefore, talipes calcaneus is the reverse of talipes equinus. This form of talipes is shown in Fig. 36.

Fig. 36.



Congenital calcaneus is the least important of the several varieties of talipes; for the distortion is easily removed by manipulation and bandaging only.

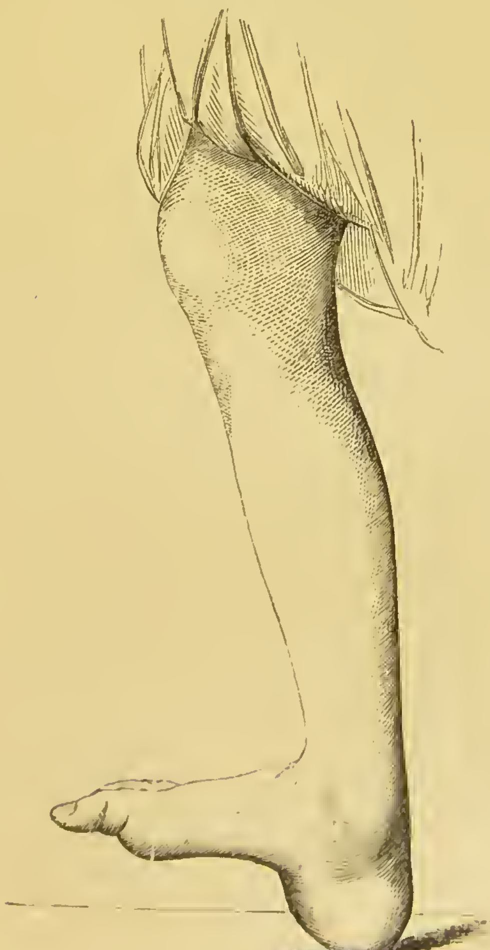
But should the normal position of the foot not have been acquired before the child begins to walk, the muscles of the calf of the leg, which extend the foot, rapidly overcome this abnormal action of the flexors and bring the sole to the ground. Cases are occasionally seen, however, in which structural shortening of the flexor muscles has taken place, and where, consequently, operative proceedings are necessary to restore speedily the normal position of the foot. In these rare cases the tendons of the flexor muscles require to be divided as they pass over the ankle-joint. The foot should then be supported on a well padded, flexible splint; and, at the expiration of a week, slight, gradual extension, as in the other forms of talipes, is to be made until the normal position of the foot is obtained.

NON-CONGENITAL TALIPES CALCANEUS

Non-congenital talipes calcaneus is usually of paralytic origin: the heel drops through paralysis of the muscles of the calf of the leg. Here, therefore, as in congenital calcaneus, the heel first touches the ground in walking. The principal changes to be observed, then, in this form of talipes are depression of the os calcis, elevation of the anterior portion of the foot through retraction of the flexor muscles of the foot, and shortening of the plantar fascia; through which the sole becomes deeply arched, and the heel and the ball of the great toe

Fig. 37.

Fig. 38.



become further approximated. (See Figs. 37, 38, and 39, which represent different degrees of this

Fig. 39.

distortion.) In this deformity, especially when it arises from paralysis, the muscles of the calf of the leg undergo wasting and fatty degeneration. And, when distortion is of long standing, not only are the muscles of the calf of the leg attenuated, but all the muscles of the leg will have passed into a state, more or less, of fatty degeneration. Figure 39 is taken from the most severe instance of deformity of this kind that I remember to have seen. Here both heels were affected in an equal degree.

Treatment.—It is seldom necessary, in the treatment of this affection, to divide the flexor tendons. The plantar fascia generally requires to be divided, and subsequently mechanical treatment will improve the shape of the limb. If, however, these cases are seen soon after distortion has arisen, not only

may much deformity be prevented by the adaptation of mechanical means, but it is probable that muscular power may be in part or even wholly restored by means of stimulating applications, warmth, and galvanism. Unfortunately, however, these deformities often are not seen until much time has elapsed—when loss of power is probably to a great extent permanent. After the shape of the foot has been restored by acting on the longitudinal arch, an elastic band may with great advantage be affixed to the heel of the boot and above to the calf-plate of the leg support: it is the best substitute we have to offer for the active muscle.

Of *calcaneo-varus* and *calcaneo-valgus* I have to observe much the same as I have already said of equino-valgus—namely, that they do not deserve separate mention. In the former, together with depression of the heel, there is also slight inversion of the foot; while in the latter there is depression of the heel and slight eversion of the foot.

Disease of the ankle-joint may give rise to various deformities. It has already been said that valgus may result from disease of the ankle-joint. Flat-foot arising from this cause is not a direct result of disease, however, but is consequent on the position of the limb. Again, when the joint becomes diseased, the foot is somewhat extended upon the leg; or, being supported, the foot is maintained either at a right angle with the leg, or perhaps at an acute angle. Hence there may result, as a consequence of inflammation of the ankle-joint, either equinus or calcaneus or rectangular contraction. The mobility of

the joint may be destroyed by true ankylosis or it may be impaired by false ankylosis; or, again, cicatrices and adhesions may induce muscular retraction and articular rigidity.

It may be here mentioned that disease of some of the tarsal bones, especially of the astragalus and of the os calcis, not unfrequently occasions muscular retraction and articular rigidity. I lately treated an interesting example of this form of irritation in the hospital, where a portion of the os calcis had become necrosed, and irritation had given rise to retraction of the muscles of the calf of the leg, so that the ankle-joint was held immovably fixed, and the heel was raised fully one inch from the ground. The diseased bone was removed, and the wound soon afterwards healed. The heel remained raised, however; so I divided the tendo Achillis, and after union was complete the motions of the joint were perfectly restored. This case was immediately followed by two others of a precisely similar character, not in the hospital, however; and in each case the result was equally satisfactory. In each instance the primary inflammation was excited by an accident; such as a kick, falling down stairs, and falling from an inconsiderable height and at the same time twisting the ankle. In each of these instances the child was a dark-haired girl: one was a Jewess.

Treatment.—The treatment of distortion arising from disease of the ankle-joint involves the treatment of ankylosis; so to avoid repetition, I will reserve what I have to say on this subject for the present, and will refer the reader for information to

the chapter on ankylosis. Where muscular retraction exists, giving rise to rigidity of the joint, with or without soft adhesions, it is necessary to divide the tendons of the retracted muscles, and gradually to restore the position of the foot in its relation to the leg by means of Scarpa's shoe or with some similar form of instrument. And thus, where the muscles of the calf of the leg are retracted, causing the heel to be raised, the tendo Achillis should be divided; but where the heel is depressed, the flexor muscles, especially the extensor longus digitorum, and perhaps the tibialis anticus and the extensor proprius pollicis, will require to be divided. Where the contraction is rectangular, it may be sufficient alone to divide the Achilles tendon. In all cases, however, of rectangular contraction with false ankylosis, where the adhesions require to be ruptured, it is necessary to divide both the extensor and the flexor tendons before the adhesions are ruptured, or such of them which appear to be retracted and are likely to offer themselves as impediments to the free motion of the joint. Mary C—, lately a patient in the hospital, is a good illustration of this operation. She was admitted with false ankylosis of the ankle- and knee-joints. The rigid tendons around the ankle-joint were divided subcutaneously, and subsequently the adhesions were ruptured, after the administration of chloroform. The knee was operated on later. Perfect motion was obtained, both in the knee and in the ankle-joints.

CHAPTER VIII

CONTRACTIONS OF THE LEG AND THIGH

Congenital contractions of the leg, equally as those of the thigh, are rare; yet there is occasionally found, together with congenital distortions of the feet, retraction of the flexor muscles of the leg, as well as of those of the thigh. Usually both limbs are together affected, and similarly, as was the case in the example which is represented in Fig. 40. In

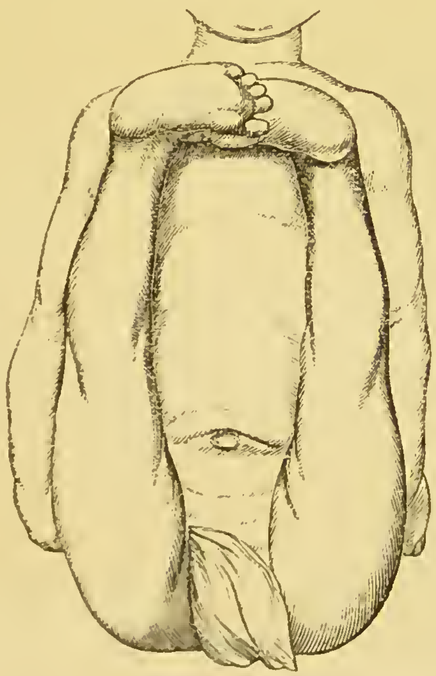
Fig. 40.

this instance there was double talipes varus and both knees were contracted at right angles. But

although it is the rule that both knees or both hips shall be contracted, exceptions occur, so that one foot and leg may alone be affected, while the other is in a perfectly normal and well-developed condition.

Again, the flexor muscles of the thigh may be so contracted that the lower limbs shall be laid flat upon the trunk, while the feet, which will probably be affected with a severe form of talipes varus, will be crossed below the chin. This deformity is well represented in Fig. 41. Not only are the

Fig. 41.



flexors of the thighs and the adductors and extensors of the feet in these cases retracted, but the extensors of the legs are also affected, so that the knees remain stiff and immovable. I am indebted

to Mr Pick for the case from which the drawing was taken. Other well-marked cases have come under my care, and in these also, as in the case above mentioned, there was talipes varus and retraction of the extensors of the legs.

NON-CONGENITAL CONTRACTIONS OF THE LEG AND THIGH

It has already been stated that these contractions are occasioned by spastic rigidity through spinal irritation; that they arise from injury to a portion of the nervous system through which paralysis is induced; or that they result from inflammation of the structures which enter into the formation of the limb, by which muscular retraction through irritation is occasioned; or otherwise that contraction is induced by inflammatory adhesion. Thus there are three pathological conditions which especially demand attention when treating of contractions of the limbs —namely, spastic rigidity, paralysis, and the results of local inflammation.

The muscles of the lower limbs which are especially affected with spastic rigidity are the flexors and the adductors of the thighs, the flexors of the legs, and the extensors of the feet. Cases are, however, occasionally met with—such as that to which I have already alluded at p. 11—where not only a limb, but the entire trunk and the extremities appear to be permanently affected with rigid spasm.

The cast, which was taken after death, shows how unchangeably the limbs were fixed in their distorted positions. Every limb, whether of the upper or of the lower extremities, was violently contracted; and not the limbs only, but the muscles of the trunk were also much affected. The spine was curved in such a manner as is seldom seen, so extraordinarily was the trunk contorted. And the muscles of the neck also were affected not less than were those of the back, giving rise to wry-neck. There was also strabismus. Less severe cases than this are, of course, more common. Indeed, it is not uncommon to find in young children spastic contraction of the adductors of the thighs, with flexion and adduction of the thighs and legs, and extension of the feet. Such children also not unfrequently suffer from weakness of the muscles of the back and neck; so that the head rolls from side to side, or it falls backwards or forwards; and they can neither sit nor stand upright. The hands also are wanting in power. Perhaps, however, the slightest and most frequent form in which this affection presents itself is that of talipes equinus or equino-varus, together with diminished muscular power in the fingers and hand of the same side.

It is a much more common occurrence, however, to see contraction of a limb produced as a result of local inflammation rather than as a consequence of the causes above mentioned. No period of life is exempt from inflammation of the joints, and there are many varieties of articular inflammation; but the liability to suffer from these several varieties is not alike at all ages. Thus, childhood is particularly

obnoxious to strumous diseases; but primary synovial inflammations are comparatively rare at this period. In the adult, however, inflammation of the synovial membranes is the rule. No joint occasions more trouble than the knee when it becomes inflamed: it is less painful than the hip, its capsule being less resisting; but, on account of its large and complicated synovial surface, it is more liable to inflammatory action than any other joint, and the effects of inflammation are very frequently disastrous. The synovial secretion is poured out in increased quantity and of a more aqueous quality than in health, causing great distention of the capsule and extension of the ligaments of the joint. The limb is at this time flexed; for this position allows of the greatest amount of distention of a joint with the least pain. The ligaments become softened and extended; and as the fluid in the joint is absorbed, the head of the tibia undergoes displacement backwards. This was the course which was followed in the case of Brewster M—, who was lately under my care in the hospital. He was admitted with a contracted knee, the result of inflammation about the joint. Abscess had formed, and a portion of the head of the tibia was necrosed. This portion of bone was lying loose in the ham, and having been removed, the wound closed. The flexor tendons were subsequently divided, and the leg was gradually extended while the head of the tibia was restored to its normal position.

Occasionally cases occur in which contraction of the flexor muscles of the leg is accompanied with excruciating pain. This is especially the case when

there is commencing ulceration. Some years since I saw, together with Sir Benjamin Brodie and Dr Metcalfe Babington, such a case. I allude to it, for I never before saw, nor have I since seen, any instance of such powerful contraction of the flexors of the leg, attended with such acute pain. Pain was incessant, and it was so severe that the patient was anxious to lose his limb. Every night he swallowed half an ounce of tincture of opium at a dose; and even that quantity not unfrequently failed to procure sleep, and it never secured for him more than one hour's rest. It was determined in consultation to divide the flexors, and gradually to extend the limb. So soon as the tendons were divided, pain ceased, and in the course of half an hour our patient was asleep, and this without the help of opium. There was no recurrence of pain. In the course of two months he again began to use his leg.

The following case was lately in Grosvenor Ward. In this instance the limb was contracted and very painful, and the pain entirely ceased on dividing the tendon of the semitendinosus muscle. The following description was written by the patient himself:

R. J. G—, æt. 30, was admitted into St. George's Hospital, May 4th, 1870, with disease of the right knee-joint. He says, "I had an attack of acute rheumatism about nine years ago, and since that time have been subject to occasional rheumatic pains in various joints, especially in the right knee. About twelve months after the first attack I noticed a small swelling, about the size of a nut, of an elastic character at the outer side of the knee. It disap-

peared after some four or five months, and was followed by slight effusion into the joint. This was so slight at first as to be scarcely perceptible; but with every attack of cold the tenderness and swelling increased in and around the joint. After three or four years the joint became tender to the touch at all times, and motion became more and more imperfect. I continued at my duties, and was accustomed to much walking and standing for many hours daily. The joint was always more swollen and tender after the day's exercise. I consulted a surgeon, who prescribed a blister over the entire front of the knee, and cinchona with hydrarg. perchlor. internally. The medicine disagreed with the stomach; and the blister was severely felt, and set up a good deal of inflammation around the joint, after the subsidence of which it felt no better. I continued to go about actively from that time, still being subject to rheumatic pains. The knee became gradually more swollen, motion was more limited, and the tenderness increased about the joint. I was in the habit of taking anti-rheumatic medicines, and applying counter-irritants—tincture of iodine, &c.—to the joint, but I never gave up my duties, nor took a day's rest. I always felt otherwise, in good health. In addition to my ordinary duties, about two years ago, I applied myself closely to study; and at this time the knee became more swollen and flexed, and motion became more limited. In July, 1869, while I was walking, suddenly I felt a severe pain, as though confined to a spot about the size of a sixpenny piece, in the interior of the joint. This spot has, since that time, always continued painful, and has caused me when walking

or standing to bring the muscles on the inner side of the thigh into unwonted action. This pain was quickly followed by a fluctuating swelling about the size of a pigeon's egg at the inner and inferior part of the thigh, immediately above the condyle of the femur. I still continued to go about, but was compelled to use two walking-sticks. On January 15th, 1870, I applied to Mr Brodhurst for advice. The joint was then greatly enlarged by effusion into, and swelling all around it, and the lump above the inner side was as large as a hen's egg. I was ordered steel and cod-liver oil; to go on crutches, and not to use the leg, but to carry it in a sling. A padded metal splint was applied to the back of the joint; counter-irritation was kept up for a few months, as well as continuous pressure by means of bandages. The swelling and effusion diminished somewhat, but the joint was becoming much deformed by displacement of the bones of the leg outwards and backwards. On admission into the hospital there was severe and constant pain along the internal and anterior part of the head of the tibia, with increasing tension of the hamstrings: the limb was more flexed, and displacement was increasing. There was also detected considerable roughness in the interior of the joint on motion. The day after admission Mr Brodhurst divided the semi-tendinosus tendon. This operation gave me instantaneous relief from all the severe pain around the head of the tibia. The limb was kept in splints for a few days, until the puncture was quite healed, when it was placed in an instrument, by means of which the limb was gradually extended to its normal shape. The effused fluid became ab-

sorbed, and, after a few months, the joint diminished to its normal size. In August last I had a severe attack of rheumatic fever, which weakened me very much, and retarded my recovery. There is now, however (October 3rd), good motion in the joint, and there is no roughness to be felt."

Congenital contractions of the toes are for the most part produced by the action of the flexor muscles. But in other cases the extensor muscles are equally contracted. Instances of congenital contraction of fingers and toes are not uncommon. These contractions may not unfrequently be traced through three or more generations. I know a family in which for three generations every member has been born with contraction of the second toe of each foot. And I am acquainted with another family in which every member is more or less lame from contraction of extensor proprius pollicis. In some dislocation has occurred; and in several members walking is painful, in consequence of partial displacement which has been occasioned by contraction of the extensor; and in these dancing is so painful as to become impossible. Contraction occurs much more frequently, however, as a *non-congenital* affection: it is often produced by wearing tight boots. From this cause one or more toes may be contracted; or they may be doubled under the sole of the foot, and they may even be almost hidden from view.

CHAPTER IX

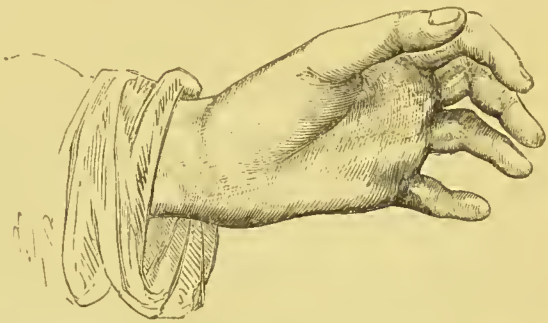
CONTRACTIONS OF THE UPPER EXTREMITY

From similar causes to those already mentioned, there is also found flexion of the forearm upon the arm, through retraction of the biceps and the brachialis anticus muscles; of the wrist, through retraction of the flexores carpi; and of the fingers, through retraction of their flexors. But of the various forms of contraction of the upper extremity, none are more interesting and of more frequent occurrence than those of the hand.

Congenital contractions of the fingers and hand are occasioned by thickening and a contracted condition of those portions of the palmar fascia which pass to the first and second phalanges, and which are attached to the ligaments of the articulation between these phalanges. The little finger is very commonly alone contracted. This may seem to be only a trifling affection: it occasions, however, considerable inconvenience; for the fingers cannot be fully expanded, and consequently, among other things, the performance of instrumental music is seriously interfered with. Occasionally, however, cases are met with where not only accomplishments are interfered with, but where the fingers are so much contracted that the ordinary avocations of life cannot be fulfilled.

Such was the case with a girl lately in the hospital, in whom all the fingers of both hands were more or less affected. The second phalanx was, in this instance, bent upon the first, as is shown in Fig. 42.

Fig. 42.



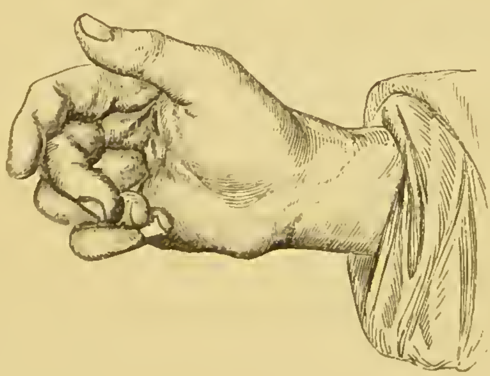
This was a congenital affection; and it rendered this patient so helpless that she could not gain her livelihood. In this instance there was more or less contraction of all the soft structures, as well as of the flexor muscles themselves.

NON-CONGENITAL CONTRACTIONS OF THE FINGERS AND HAND

Non-congenital contractions arise, for the most part in a gouty or a rheumatic diathesis, and especially where spirituous liquors are habitually taken in considerable quantities. There is always, however, some exciting cause present to induce contraction—some local irritation, together, perhaps, with exposure to cold and damp. The cab-

man's whip and reins, for instance, appear to act as causes of this common form of contraction. It may also be produced by handling a sword, by wearing a ring, or by pressure in the palm of the hand, such as is induced by the carpenter's saw or the jeweller's tool, or by leaning heavily on a stick or a crutch. In these cases the fascia in the palm of the hand undergoes chronic thickening. It is a painless affection, and its course is very slow. Contraction, for the most part, commences in that portion of the fascia which passes to the little finger: the finger becomes somewhat thickened, and subsequently it is flexed into the palm. Afterwards the ring, middle, and index fingers, and rarely also the thumb, are drawn into the palm; and they are so firmly fixed in that position that they cannot be extended. The appearance which this affection presents is well shown in Fig. 43. The process of

FIG. 43.



fascia which passes to each contracted finger becomes more and more dense as the finger becomes more contracted; and occasionally instances are seen where the

fingers are so firmly drawn down into the palm that it is difficult to introduce the knife beneath the band of fascia. And, indeed, cases are not rare where the pressure of the nail excoriates the palm of the hand.

Treatment.—The treatment of these several affections varies as the pathological condition varies. Thus, as has been already explained, in spasmodic contractions, recourse can be had to section of tendons only when irritation has entirely or in great measure subsided; for contraction would necessarily recur if tendons were to be divided at an earlier period. Until this time has arrived, counter-irritants may be employed in the course of the spine, and nutrition should be promoted to the utmost. When irritation has ceased, the tendons of those muscles which remain permanently shortened may be divided. Among others, those of the flexor muscles of the leg —namely, the biceps, the semimembranosus and the semitendinosus — require to be divided, as well perhaps as the tendo Achillis. There was lately an excellent illustration of the condition to which I am now referring in the hospital.

This child was sent up from Blackpool by Dr Risk, suffering from contraction of the extensors of the feet, the flexors of the thighs and legs and the adductors of the thighs. In consequence of this state of the muscles, the trunk was thrown forward, so that the child could not stand upright, and she could not stand without help. The flexors of the legs and the extensors of the feet were divided, and mechanical means were employed to overcome other contractions; and after some weeks of treatment the child was able to walk fairly in the ward with

the aid of a stick. The change which was produced in the form of this child, from a crouching to an upright position, was so remarkable that it might well be doubted if its mother would recognise her child. There was also a severe form of strabismus; for which the internal rectus muscle was divided by Mr Power. The removal of the squint tended much to improve the child's appearance.

In many of these cases not only are the feet crossed one over the other, but in many instances the knees overlap and are thus powerfully held and resist any attempt at separation. In these it is requisite to divide the adductors of the thighs, especially the adductor longus. Immediate and lasting relief is afforded by these sections, perhaps greater relief than is given by any other similar operation. As soon as the adductors have been divided the thighs may be separated and held widely apart by weights not exceeding two or three pounds.

As a result of infantile and other forms of paralysis, when structural shortening has taken place, tendons also require to be divided, as in the instance above cited. The result of operation in these cases is not, however, so favorable as in the former: more or less muscular weakness of the limb generally remains, notwithstanding the employment of galvanism, excitants, &c.; so that mechanical support is required for a lengthened period after the operation. Where spasm has occasioned contraction, mechanical support also is required to be worn for some time; but in these cases it may be discontinued, as the muscles begin to recover power and resume their functions.

Both in spasmodic and in paralytic affections, distortion may be prevented by the timely use of adequate mechanical means. It is only, for the most part, when such means have been neglected that contraction and structural shortening and deformities result.

When the flexor tendons have been divided, extension should be made slowly until it is complete.

The mode of division of the biceps tendon is as follows :—The patient, lying on his face, will endeavour slightly to bend the knee, which will cause the muscle to spring into action, and make the tendon tense. The tenotome will then be introduced beneath the tendon from the centre towards the outer side of the limb, and, being guided close to the tendon, it will pass between it and the peroneal nerve. The edge of the knife will then be directed upwards towards the tendon. So soon as the tendon is divided, the nerve becomes prominent, and a tyro may even doubt whether the tendon has really been divided. If care has been taken to pass the knife fairly and fully beneath the biceps tendon, on using a cutting motion the tendon will certainly be divided, and the knife may be felt covered only by the integument. The knife should then be withdrawn, and on no account should it be re-introduced. I have known more than one instance in which the temptation was felt so strongly to do this that the knife was re-introduced and the nerve divided. Temporary paralysis, of course, ensued. After the tendon has been divided the puncture should be carefully closed, and the limb should be bandaged ; and

in the course of three or four days, when the wound has healed, extension may commence.

Although I have not hitherto strongly recommended the division of the adductors of the thigh, I have formed from a large experience a very favorable impression of this operation. Its efficacy depends on the thoroughness with which it is done, and on the after-treatment. There is now a considerable series of cases recorded in which I have divided the adductor longus muscle, commencing in 1860, and since continued up to the present time.

The adductor longus is to be divided at one inch or thereabouts from the origin of the muscle, at which point the tenotome is to be entered at the outer edge of the muscle and carried well beneath it, so that on cutting inwards the entire muscle in its tendinous portion may be divided. A considerable gap is immediately produced at the seat of section. I have never known any hæmorrhage to occur from this operation. Lateral extension by means of weights attached to the lower end of the femur, the sustaining cord passing over pulleys, may commence to be made about the third day. By increasing the weights the limbs will gradually and without pain be widely and completely separated. I have done this operation at all ages, varying from three years to thirty.

Again, in contractions of the forearm, mechanical means are for the most part sufficient to overcome contraction. It is occasionally necessary, however, to divide the tendon of the biceps. When this muscle is much contracted, the tendon is raised considerably above the vessels, and may be divided without danger.

And after the biceps tendon has been divided, the brachialis anticus muscle and any other contracted structures yield readily to extension. Contractions of the wrist-joint also generally yield to mechanical means when there is not any displacement of the bones of the carpus. When the hand is displaced backwards or forwards, it may be necessary to divide the flexor tendons before the articular surfaces can be placed in apposition.

When one or more toes are contracted in children, gentle bandaging will for the most part remove this deformity; but in later years, when the flexor tendon is rigid, it is necessary to divide it. In the adult, it is impossible to remove a well-marked deformity of this kind without dividing the flexor tendon. The tendon should be divided opposite to the first phalanx, and the puncture having healed, extension should be made slowly. And in a similar manner the extensor tendons may require to be divided. This is much more rarely required, however, and when it is done extension should be made more slowly, for the resistance is less. Even now-a-days we hear of proposals to amputate contracted toes, and especially the little toe, for there is supposed to be some special difficulty in restoring the little toe to its normal position; and consequently amputation is suggested as the shortest mode of removing deformity. It should also be remembered that this short method of cure irrevocably maims the foot. I need scarcely say that the idea of amputation of a toe should not be entertained where it is not absolutely necessary. Nothing is easier than to restore the position and action of toes thus

circumstanced by dividing the flexor or the extensor tendon, as the case may be, and by using subsequently gradual extension.

In contraction of the palmar fascia, mechanical extension will sometimes be sufficient to remove the distortion. In general, however, extension is exceedingly painful, and cannot be borne. Recourse should then be had to division of each contracted portion of fascia. So soon as the punctures have healed, extension should commence, and be carried on as rapidly as it can be borne. The palm of the hand must then be fully unfolded and the fingers extended; for should any portions of fascia remain contracted, the fingers will again in time be drawn into the palm of the hand. It is not always necessary to divide the fascia in its entire thickness, but only the densest portions. These being divided the remainder may be unfolded by means of pressure, applied as with the end of the finger, or through extension, such as is made by gently opening wide the fingers.

Fig. 44.

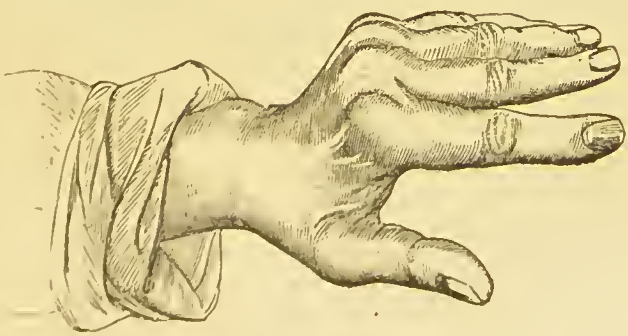


Fig. 44 is intended to represent that form of

contraction which is caused by chronic rheumatic inflammation of the hand.

I introduce this figure without further comment, and merely for the sake of distinction; for although there is contraction here, there is no analogy between this and the other forms of distortion which have now been described. In these there is simply contraction of the more superficial textures: sometimes the tissues external to the flexor tendons are alone affected, while in others the flexor muscles are retracted as well as the fascia and other soft tissues; but in this last-mentioned instance deformity is induced by disease of the articular surfaces.

PART II

DISEASES OF THE JOINTS

CHAPTER X

ANKYLOSIS

Ankylosis is either true or false. True ankylosis, or synostosis, implies that bony union has taken place between the adjacent bony surfaces, and that the soft structures of the joint have been destroyed; and by false ankylosis is understood the formation of membranous, or fibrous adhesions within or external to a joint, and which interfere with motion.

Fibrous ankylosis.—False, partial, or fibrous ankylosis is induced by the deposition of lymph within or around a joint through which adhesions are formed which interfere with motion. Under these circumstances motion may be only slightly impeded, or it may be in fact lost. If the muscles about a joint, or the tendons which pass over the joint, can be rendered prominent, or tense, ankylosis is not complete; neither is it complete, or bony,

should the slightest motion remain. And even though motion be lost, the same sensation of solidity is not imparted to the hand on grasping the limb firmly above and below the articulation, as when bony ankylosis has taken place.

Fibrous, or false ankylosis may be divided into two classes, which may be severally designated extra-capsular and intra-capsular.

Extra-capsular ankylosis depends on inflammatory action, such as is induced by burns, phlegmonous erysipelas, mechanical injuries, or indeed by every form of inflammation through which lymph is deposited around a joint; while *intra-capsular ankylosis* is occasioned by various forms of inflammation which have affected the structures within the joint, and through which adhesions have been formed.

Thus, the fibrinous deposit, whether within the joint or external to the capsule, becoming organised, constitutes false ankylosis.

Lymph is poured out into the cellular tissue around a joint, and about the sheaths of the tendons and muscles in its immediate vicinity; it becomes organised, and the parts are more or less matted together and fixed, whether in an extended or in a flexed position, and their functions are impaired. And when the interior of the joint is affected instead of that portion of the limb external to the capsule, then, in a somewhat similar manner, adhesions are formed between opposed surfaces: the inflammatory product becomes organised, and motion is hindered. Both in intra- and in extra-capsular inflammation the amount of injury to the limb will depend in some measure on the character of the inflammation. It

will depend much more, however, on the mode in which that inflammation has been treated; whether attentively from the commencement, with absolute rest, or negligently—allowing the use of the joint; for in proportion as the inflammation is of long duration, so in all probability will the adhesions which form be dense and extensive. In many cases the adhesions are slender, but although slender they may entirely prevent useful motion; or, again, they may be more extensive, and yet yield and allow of increased motion. When, however, disease is arrested, and the interior of the joint is restored to a healthy condition, while the articular surfaces occupy their normal positions, the adhesions which have formed may be so dealt with that motion may be restored.

There is a form of inflammation, known as gonorrhœal inflammation, which gives rise to ankylosis perhaps more frequently than any other form of inflammation in and about joints. In this form of inflammation, serum is effused into the synovial cavity to so great an extent as to produce excessive swelling and tension of the integuments. Suppuration, however, never occurs; but lymph is deposited on the synovial membranes, through which adhesions are formed between the opposed surfaces.

When effusion has taken place, the limb remains in a semi-flexed position; for in this position the structures around the joint are more relaxed than in an extended condition of the limb. The effused fluid may be removed, and the joint may resume its healthy action, but more or less stiffness will remain during several weeks, and a crackling sensa-

tion will probably be communicated to the hand on moving the limb. Notwithstanding that effusion may be very considerable, dislocation never takes place in this form of inflammation, and this fact may be said to be diagnostic of the disease; for whereas in every other form of articular inflammation, the tendency is for the articular surfaces to become displaced, in this form, where the effusion into the joint is perhaps greater than in any other form of inflammation, displacement never occurs.

The patient having once suffered from this form of inflammation is extremely liable to a recurrence of it. The inflammatory attack will probably not be more severe on the second occasion, but the damage to the affected articulations will be greater, and one or more joints may remain ankylosed. Thus, each attack of inflammation appears to be more virulent in its character, and to leave behind it more trace of the disease than the previous one. The knee-joint is perhaps affected more frequently than any other joint; but the hip also suffers, and scarcely less frequently.

Some time ago I saw F. C—, a young lieutenant, who, serving in a tropical climate, contracted gonorrhœa. Whilst the urethral inflammation was still acute he exposed himself to damp, sleeping after sunset in the open air, and on waking experienced great pain all over the body, but especially in one hip. This hip was excessively painful, and the effusion was so great that it was thought suppuration must ensue. Neither, however, did suppuration take place, nor did the head of the femur become dislocated; but false ankylosis of a very firm cha-

racter resulted from this attack of gonorrhœal rheumatism.

Besides the hip-joint, both shoulders, one knee, and an ankle-joint became inflamed at the same time, but, with the exception of the hip, all these joints passed through the inflammatory condition without material injury; and at length they recovered perfectly.

Sometimes the urethral discharge seems to alternate with the articular inflammation. Thus, the urethral discharge will cease as the articular inflammation becomes developed, and it recurs as the articular inflammation subsides. I have known this alternation of inflammation to continue for several weeks, and at length ankylosis to result from it.

The first attack of gonorrhœal rheumatism, if promptly treated, may terminate in a perfect recovery, and without leaving behind it any ill effects. And a second attack may also terminate in a similarly fortunate manner, though this may be considered to be a rare piece of good fortune. But a third attack of inflammation usually leaves some unpleasant remembrances. The following is a case in point.

A gentleman wrote me a note, asking me to go to him, as he wished to consult me, but could not come to me. When I saw him, he told me the following history :—

When he was twenty-five years of age, he contracted a gonorrhœal discharge, which was followed by synovial inflammation with effusion into both knee-joints. He was confined to the house during a fortnight or three weeks, and was then again able to walk about. At this time, however, the swelling

and stiffness of the knees had not quite subsided. The urethral discharge continued for two months, and then it ceased. Before three months had elapsed, the use of the knees was perfectly restored. At this period, he again contracted a gonorrhœal discharge, and it was followed, in the course of some few days, by inflammation of the left hip-joint, of both ankle-joints, and of the tarsal joints. The swelling and stiffness lasted longer on this than on the previous occasion, and, indeed, ten months passed before he was able to walk with sticks. Stiffness continued after this time yet for many months, but at length he regained the use of the affected joints.

In November, 1852, a similar series of events occurred as before. On this occasion, however, both hip-joints became inflamed, as well as both ankle-joints and one knee-joint. The effusion and pain were greater on this than on any previous occasion, and he was longer in recovering. Indeed, he never entirely lost the stiffness about the hips, and always had difficulty in rising from a chair.

In 1854 he married. Articular inflammation returned with redoubled violence, without any urethral discharge being present, and attacked in succession every articulation in the body.

I found him with ankylosis of all the cervical vertebræ, and of most of the dorsal vertebræ, as well as of both hips. Subsequently, ankylosis took place of the temporo-maxillary articulations, the shoulder-joints, and the knees. And before death took place the entire skeleton was ankylosed: he could not even move his head.

The recurrence of this form of inflammation is sometimes very remarkable. I saw, with Dr William Ogle, in the hospital, E. G—, aged 46, on account of considerable effusion into, and thickening about, the knee-joint. Ankylosis had taken place of the wrist-joint, the vertebræ, and the ribs. The breathing was diaphragmatic.

In the year 1855 (thirteen years prior to his second admission) he was a patient of Dr Wilson's, in Cambridge Ward, for gonorrhœal rheumatism. Since that period he had never had gonorrhœa, but had at various times suffered pain in different joints, and is conscious that gradually his back and neck, as well as the wrist and knee, have become stiff.*

In many cases of partial ankylosis there is, also, partial displacement of the articular surfaces. Some of these admit of rectification of the limb. In the majority of instances, however, this amelioration can only be partially accomplished, and it cannot always be maintained even after tenotomy has been performed. It is unnecessary to say that there can be no hope of restoring motion in a permanent manner, unless the position of the limb as regards the articular surfaces is first restored.

Treatment.—The treatment of partial ankylosis may be divided into—1st, gradual extension with or without tenotomy; and 2nd, immediate flexion of the limb, with or without tenotomy, and subsequent gradual extension.

* For further information on this subject, I must refer to the article on "Gonorrhœal Rheumatism," in Dr. Russell Reynolds's 'System of Medicine,' 1870.

In all cases of partial ankylosis there exists some muscular rigidity. Also, in some cases, cicatrices are found, resulting from loss of substance. Where adhesions are recent, contraction of a limb may probably be overcome by continued extension—such extension, namely, as is made by means of a well-adjusted instrument for the purpose. But, except in cases of recent adhesions, it is generally necessary to commence the treatment by dividing the tendons of rigid muscles and cicatrices subcutaneously. It is better to proceed at once to these subcutaneous sections rather than to prolong the treatment by extension unnecessarily; for unless the adhesions are recent, simple extension is seldom of itself and uncombined with subcutaneous sections sufficient to remove the contracted condition of a limb. It is important to remember this principle of treatment, for partial displacement of the articular surfaces is easily induced by continued extension of the limb, unless the tendons have been previously divided. Indeed, it is not uncommon to see this displacement take place at the knee when extension is long continued and where the tendons have not been divided. Whenever, therefore, it is desired to remove contraction, it is the rule first to divide the tendons of rigid muscles and to divide cicatrices subcutaneously, and subsequently to proceed gradually to extend the limb.

But if such be the law of treatment where the articular surfaces occupy their normal positions, it is even more to be insisted on when any displacement has taken place. Extension should then without fail be preceded by the subcutaneous section of such

tendons, fasciæ, and cicatrices as might interfere with the re-adjustment of the articular surfaces.

These obstacles to extension then having been removed, a well-adapted instrument is to be applied to the limb, and extension is to be made slowly. The instrument should support the limb efficiently; and it should always, in the first instance, be applied at that angle, whatever it may be, at which the limb was held before the subcutaneous sections were made. So soon, then, as the punctures have healed, extension may commence and be carried on gradually without producing pain and without occasioning displacement.

Numberless cases, however, exist in which the means above mentioned are useless to restore to the limb either the normal position of its parts or to restore motion; cases, for instance, in which the adhesions are so firm that they do not yield to gradual extension. The pressure produced by continued extension may occasion destruction of the integument, or it may induce displacements, partial or complete, of the articular surfaces; but the adhesions, whether intra- or extra-capsular, will not yield to such force. Injury alone, but no useful result, can accrue from gradual extension in these cases. Before chloroform was introduced, these were among the *opprobria* of surgery. Then, gradual extension of such limbs was continued for months, and even I may say for years, without any advantage being derived.

Thus, it is necessary, before proceeding to the treatment of a case of this kind, to form a correct diagnosis—to determine in fact whether complete an-

kylosis has taken place or whether the adhesions are fibrous ; and if fibrous, whether they will or will not yield to gradual extension. If these several points cannot be otherwise determined chloroform should be fully administered, so that when muscular relaxation has been obtained, both the character of the adhesions and the amount of motion of which the limb is capable may be fully ascertained.

Here I will continue the case of F. C—, which I commenced at p. 122. He returned to England to ascertain if anything could be done for his stiff hip, for unless motion could be restored he must leave the army. He consulted Sir Benjamin Brodie, who assured him that he " must take his stiff joint with him to the grave." Soon after this I saw him in consultation with Dr Wood; and finding that joint-motion was not absolutely obliterated recommended that chloroform should be administered and that an attempt should be made to flex the limb. This was agreed to, and chloroform was administered. When he was fully under the influence of chloroform I steadied the pelvis with one hand and with the other jerked the thigh upwards, when the adhesions instantly yielded and the limb was free. There was neither pain nor tenderness experienced after the operation. He wore a gutta-percha splint for six days, to keep the joint motionless; and after that time passive movements of the limb were made daily. Before three weeks had elapsed he walked more than two miles without resting. Two months after the operation he was subjected to an examination by several medical friends, when to my surprise and to that of all present it was found that he not only

had complete and perfect motion of both hip-joints, but that one was exactly similar in every respect to the other. I feel some diffidence in completing this history, which I regret to say is not altogether a common one; but I may be allowed to say, odd though it sounds, that out of six persons who were present there was not one who had so great extent and freedom of motion of the limb as the patient himself. I need perhaps scarcely add that he did not sell his commission; but soon afterwards he obtained his promotion.*

When bony union has taken place, a sense of solidity and continuity of structure is communicated to the hands on grasping the limb above and below the articulation; but when fibrous adhesions have formed, either slight motion may be felt at the articulation, or at least a sense of elasticity is communicated on endeavouring to flex the limb. And if the adhesions are of such a character—so firm and unyielding—that motion as well as the normal position of the limb can only be gained by force suddenly applied to rupture the adhesions, the force should be so applied that it is used mainly, if not entirely, in flexion of the limb.

Examples of this mode of treatment are mentioned by Meckren, Bartholin, and Amussat. The latter communicated an instance to the Académie de Médecine, in 1831, where forcible flexion had been performed. But the operation may indeed be said to have been instituted by Louvrier, whose attention had been especially directed to cases of this description. He was successful in the first five cases which

* 'Medico-Chirurgical Transactions,' vol. xl.

came under his care. Afterwards he sought a larger field for his ambition, namely in Paris; and, not being able to distinguish between true and false ankylosis, accepted for operation every case of ankylosis which presented itself in the hospitals; and he was then as unsuccessful as he had been previously successful.

Palasciano, with more pathological knowledge than Louvrier, followed in his footsteps, and with more success; and having again directed attention to the operation, it was practised especially in Lyons, Berlin, and Vienna, by Bonnet, Buehring, Berend, Schuh, Lorinser, and others.

As practised at that time, and before chloroform was in use, this was a terrible operation. Dieffenbach was among the first to modify the operation. He first divided contracted tendons subcutaneously, and immediately afterwards ruptured the adhesions. In many instances, in consequence of the force which was employed, the punctures were extended even into lacerations.

Langenbeck also saw in this operation a means of restoring power to a crippled limb; and, availing himself of the inhalation of ether, he thought it was unnecessary to divide the tendons of contracted muscles, and therefore divided the fasciæ only, and then ruptured the adhesions. But, notwithstanding the advantage which anæsthetic agents gave him, his operations were not so successful as were those of Dieffenbach: displacements more or less complete were frequently produced.

It was only when tenotomy and anæsthesia were combined that the operation of forcible flexion could

be looked upon as free from danger. I have performed upwards of 800 operations of this nature, and have never known any *contretemps* whatever—neither fracture, nor dislocation, nor pyæmia, nor inflammation.

Professor Bauer says, "About 600 cases of affection—contraction and ankylosis—of the knee-joint have given me ample opportunity for most thorough clinical observation, and entitle me to participate in the important question which is still being discussed before the highest scientific tribunals of Europe. On the feasibility of forcible rupture of adhesions all are agreed. Its superiority over gradual extension can no more be questioned; and its former opponents have been effectually silenced by the overwhelming results which have been produced."*

Any tendons which are rigid should first be divided; and the punctures having healed and chloroform having been fully administered, the limb to be operated on should be so firmly fixed that all motion is prevented, except that which the operator is about to impart to the limb. Thus, for instance, if the hip-joint is to be operated on, the pelvis must be fixed; if the knee, the thigh must be securely held; and so on. When the limbs are thus firmly secured, the adhesions are to be instantaneously ruptured, by force applied in the direction of flexion. I say that the adhesions are instantaneously ruptured, when the patient is properly prepared, and the force is rightly adjusted. The limb is then to be bandaged, and especially the affected joint is to be firmly bandaged and confined either in

* Op. cit., p. 113.

a gutta-percha splint or on a flexible metallic splint.

I know of no danger whatever from the use of force so applied. Indeed, when the influence of the muscles is perfectly removed, the adhesions themselves usually offer very little resistance; and if the power to be applied is sufficient for the purpose, the result is instantaneous. In a small number of instances, the hand alone is insufficient to rupture the adhesions readily; and in these I make use of an instrument to flex the limb. Not only is there no danger connected with this operation, but with moderate care it would seem to be impossible to set up unhealthy action. It is sometimes said that in these operations fracture is not uncommon, and that inflammation is not unfrequently excited. Let it be sufficient for me to say that I have never seen a fracture produced, nor have I known inflammation to occur, nor any other ill whatever to follow an operation of this nature. When disaster ensues it is from abuse of the operation. I know that some unfortunate results have occurred; such as fracture of the femur and the humerus; but in these cases chloroform was insufficiently administered, and the motor force was improperly applied. I cannot tell what might be the result of adopting such instructions as the following, which I copy from one of the latest works on the subject. After describing the preliminaries of the operation, the author proceeds thus: "A cracking noise is heard, which becomes more and more evident as the movements are continued, and at the end, it may be, of *half an hour* the adhesions may have so far given

way as to allow of motion in all directions to a very considerable extent, in a joint which had appeared completely ankylosed." This, however, is not the manner in which this operation ought to be performed. When carefully performed this may be said to be the most successful operation in the whole range of surgery. And it may be added that there is not one more free from danger.

When the joint retains its normal external form, the adhesions are easily broken down by the hand, after the limb has been properly placed in position and the full effect of chloroform has been obtained. There was lately a case under my care in the hospital, where the patient having suffered from rheumatic inflammation was admitted with partial ankylosis of the knee and of the ankle. The tendo Achillis was, in the first instance, divided, and after the puncture had healed, the adhesions were ruptured by flexing the foot upon the leg. On a subsequent occasion the hamstrings were divided subcutaneously, and, the punctures having healed, the adhesions at the knee-joint were ruptured by flexing the leg upon the thigh. This patient walked well when she left the hospital, and without lameness; and the movements at the knee- and ankle-joints of the affected limb were as free as were those of the sound limb.

It is a point to remember that, after the tendons have been divided and before the punctures have healed, the adhesions should not be ruptured; or they should be ruptured only with great care, lest the puncture should be extended into a rent. This extension of the puncture is much easier to effect

than might be supposed, and it is, therefore, safer to allow the punctures to heal before any motor force is employed.

When the position of the limb is perfectly restored passive motion should commence. At first it may be necessary to administer chloroform, for motion is painful; but, as motion increases, passive movements excite less pain.

The notes of the following cases of ankylosis of the knee and of the elbow were supplied to me by my house-surgeon Mr Walker; and will serve as illustrations of the treatment which is for the most part adopted in these cases.

A. B—, æt. 12. Was admitted November 2nd, 1869, into Grosvenor ward. A year and a half ago he fell down and severely injured (he says dislocated) his elbow. He was brought to the hospital, and the arm was placed in an angular splint. He attended as an out-patient for two months, during which time he wore the splint.

In September, 1869, it was noticed that the arm was contracted. This contraction increased until the arm became flexed at an acute angle, and so it became fixed. In this condition he was admitted as an in-patient under Mr Brodhurst.

On the 7th of December it was found that ankylosis of the left elbow had taken place, and that the adhesions were so firm that there was no movement at the joint. Chloroform was administered, and the adhesions, which were firm, were ruptured. The limb was placed on an angular splint, and so it was left for four days. The splint was then removed,

but the bandage around the joint was allowed to remain. As there was some tenderness still about the joint, it was kept quiet for a few days longer, when the splint was taken off, and passive motion and friction were employed.

On the 24th of December he was made an out-patient, and in the course of six weeks had regained completely the motion of the limb. And although the power of the limb was not so great as that of the other arm, the extent of motion was alike in both.

September 19th, 1870.—Has perfect motion in the joint, and can use the two arms alike.

J. G—, æt. 22, valet. Admitted into the Grosvenor ward, May 11th, 1870, for ankylosis of the left knee. Six months ago, whilst with his master in America, he fell from a bicycle, whereby he gave his knee a slight twist. He felt very little pain at the time, and was not obliged to keep his bed. Six weeks after the accident, having returned to England, he contracted gonorrhœa. Some days after this his knee suddenly became painful and swollen, and he was compelled to keep his bed. At the same time the gonorrhœa ceased. He was admitted into the hospital on December 11th, under the care of Mr Henry Lee, and under treatment the inflammation gradually subsided; but there was left fibrous ankylosis of the joint with immobility. He was again admitted in May, under Mr Brodhurst, that it might be ascertained if some amount of motion could be restored to the joint.

May 13th.—The adhesions, which were very

dense, were broken down under chloroform; after which a splint was applied, and the joint was firmly bandaged. Scarcely any pain was felt after the operation.

This operation was followed by a considerable amount of motion.

June 23rd.—He was again put under the influence of chloroform, when the joint was again moved and other adhesions were broken down. Passive motion and friction were subsequently used, and in September he was discharged, having gained power to bend the knee at a right angle and to straighten the leg perfectly.

It is sometimes said that it is better to trust to the hand only in producing immediate flexion of a limb rather than to have recourse to instrumental aid of any description. And this is also entirely my opinion. I should even consider it blamable to use instruments until the hand had failed, or to use them except with certainty of success; and then only with great care and moderation. There are a certain number of cases, however, where the patient would remain crippled for life unless something more were done than can be accomplished by the unaided hand. These cases I confess I am not prepared to abandon.

I will relate only one case, which I saw some years ago. W. E— was sent to me from the West Indies by Dr William Clarke. He had suffered from gonorrhœal rheumatism, and several joints had been inflamed. Those of the upper extremities recovered without any loss of motion; but both hips

and both knees remained stiff. He called on me one morning when I was out of town; and forthwith proceeded to consult one of my colleagues. This gentleman placed him under the influence of chloroform and with the unaided hand endeavoured to flex the limb; but failed. It was supposed that there was nothing more now to be done, so he took his passage in one of the large ocean steamers to return home. The day before leaving he remembered, however, that he had never delivered Dr Clarke's letter, so he brought it to me. Not knowing what had already occurred I examined the hips and knees, and expressed an opinion that motion might be obtained. I was forthwith requested to make the attempt. Then I heard what had already been done.

The apparatus, as shown in Fig. 45, having been well secured to the bed, the patient was so fixed in it that the pelvis could not move, while the limb to be operated on was strained up to the utmost by a cord which passed over a pulley. During this period Mr Clover placed the patient most efficiently under the influence of chloroform. I had the great advantage of the presence of Sir William Fergusson and of Sir William Gull during this trial, and I shall be forgiven if I mention that Sir William Fergusson when he saw the limb strained up, said, "I see you intend to do it, but I doubt if you will accomplish it. I saw considerable force employed some days since when he was under chloroform, but no impression was made on the joint." The patient being at length fully under chloroform, whilst the thigh was strained up by an assistant and the ankle was supported by a second, I placed the

right hand behind the lower end of the femur and with slight force jerked the limb upwards. Instantly the adhesions yielded with a loud snap; and so loud indeed was it that it was heard in the next room, the door between the rooms being open. Some of the by-standers believed that the neck of the femur was fractured. I however could feel the smooth motion of the head of the femur, and so placed the limb in Sir William Fergusson's hands, who immediately expressed himself satisfied with the result.

This case illustrates then the advantage to be derived from properly directed mechanical force in addition to that of the hand.

Dr Lloyd has kindly furnished me with the following notes of a case of ankylosis of the hip on which I operated with him:

F. P—, æt. 37. Had in 1854 an attack of gonorrhœa, which was cured in about six weeks. In the following year he had an attack of rheumatism (gonorrhœal) in the right knee. The inflammation was attended with very acute pain and much swelling in that joint. No other articulation was affected. He kept his bed for two months during this illness, and it was several months before he was able to follow his employment. Having recovered he remained in good health for six years; but in the year 1861 rheumatism of a subacute character attacked his right hip, and it became stiff in the year 1863. At this time he again suffered from gonorrhœa, which was acute and lasted for four or

five weeks. Before the gonorrhœa had quite left him the rheumatism in the hip became very acute, and the joint remained painful for twelve months, during which time he was confined to his bed, or sofa. Ankylosis and contraction of the limb resulted from this attack, and he also at this time suffered from considerable general debility.

Between the years 1863 and 1869 the only treatment to which he was subjected consisted in the use of hot and cold baths, but, on going to St Petersburg, in 1869, he consulted Bokoff, who told him he was suffering from disease of the spine; cold baths and electricity were ordered for him with benefit to his general health.

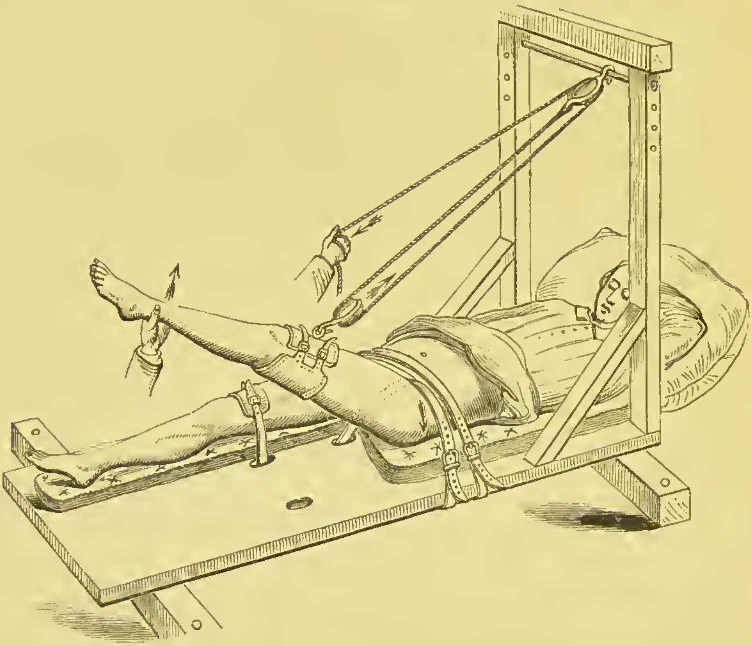
In August, 1870, he consulted Dr Lloyd, who found that ankylosis of the right hip-joint had taken place. Dr Lloyd at once consulted with Mr Brodhurst, and it was agreed that an attempt should be made to break down the adhesions under the influence of chloroform, which was done by Mr Brodhurst on the 15th of August.

The adhesions were instantly broken through, and the entire motion of the hip-joint was obtained. Only slight pain followed the operation. In two days the splint, which was applied immediately after the operation, was removed, and passive motion commenced. The patient in the course of a fortnight was able to plant his foot firmly on the ground, and rest considerable weight upon it. From that time the increase of motion and strength was rapid.

The following figure gives a good idea of the apparatus which was used in the last-mentioned

cases. It shows how the pelvis is to be fixed and how the forces are to be directed, so that immediate flexion of the limb may be obtained.

Fig. 45.



In the following case, from which Fig. 46 was taken, unlike those which have gone before, the articular surfaces did not retain their normal positions; but the leg-bones were in part displaced backwards.

A. H—, twenty-three years of age, had suffered from abscesses about the knee for several years. Both the leg and the thigh were much scarred through abscesses which had formed and broken. Portions of the femur had been exfoliated, and part of the tibia was exposed when I first saw him. There was

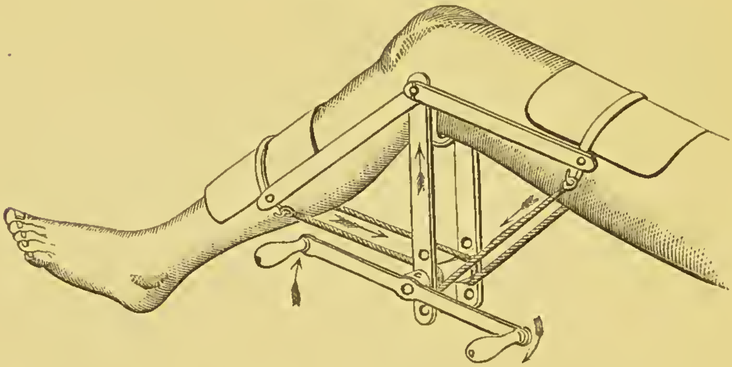
no appreciable motion at the knee-joint, and the tibia was partially displaced backwards. The limb

Fig. 46.

was useless for walking: no weight could be borne upon it, so that crutches were always used. I was requested to restore the motion of the joint. I declined to attempt immediate flexion of the limb however, and advised that resection should be thought of; but this advice was not acceptable. Three days later this same patient again presented himself, and importuned me to attempt to straighten

his limb; and at length it was arranged that an examination under chloroform should be made. Eventually the hamstrings were divided; and subsequently an instrument consisting of metallic splints, connected with a roller in the popliteal space by means of catgut cords, and acting on the principle of the wheel and axle, so that when put in motion the splints were approximated, having been adjusted to the thigh and leg, and moved, the knee was bent. This instrument is seen in the following figure, for

Fig. 47.



the sketch of which I am indebted to Mr Gumpel. So soon as the cords were tightened and pressure was applied the adhesions gave way instantaneously with a loud snap. The instrument was immediately disengaged, and the limb was bandaged and supported with splints. Especially the knee was firmly bandaged. I was assisted in this operation by Dr Jones and by Mr Pick. Opium was administered, and its effect was continued more or less for three days. At the end of a week gradual extension was commenced, for there was no inflammation after this operation; and thus the leg-bones were replaced, and the length

of the limb was restored. Before he left London my patient walked about his room freely and without a stick, and with a stick he walked easily round Grosvenor Square, having gained a considerable amount of useful motion at the knee-joint.

I will introduce one case to illustrate the lasting effects of this operation. And because there is no joint to which it is so difficult to restore motion as the elbow-joint, I select the following case :

Mr Henry Lee recommended a gentleman, Mr G—, who had been in China and there had suffered from inflammation of several joints, and among others the left elbow, to consult me. All the other joints had recovered perfectly, and there was not any stiffness left except in this one; but the elbow remained stiff. Immediate flexion was employed while he was under the influence of chloroform, and within one month he returned to China having recovered good motion. Three years later I met him accidentally in London and inquired after his elbow. "It is perfectly well," he said, at the same time moving his arms vigorously. "Indeed," he added, "I have entirely forgotten which was the stiff elbow : both arms are now exactly alike." On examining I could not distinguish any difference between the two elbows.

The operation of rupturing fibrous adhesions is commonly spoken of as forcible extension of the limb; and the term is in consequence misunderstood and the force is misapplied ; so that, instead of flexing a limb, attempts are made to extend it. This mode of treatment is entirely a misconception of the idea which is intended to be conveyed however.

Indeed, such an application of force can scarcely fail to produce lacerations and consequent suppuration; or it may, indeed, occasion fracture or dislocation. But when the force is applied in flexing the limb, and immoderate force is not used, no danger can accrue to the patient.

Ankylosis of the jaw takes place either in consequence of cicatrices through injury to the mucous membrane of the cheek, or otherwise through inflammation of the temporo-maxillary articulation.

A cicatrix which results from destruction of the mucous membrane, even though it should not extend entirely from one alveolar border to the other, gradually and slowly contracts as cicatrisation becomes complete. At length the teeth are firmly fixed one row upon the other so that they cannot be separated; and perhaps the only motion of the jaw which remains is a slight lateral motion. This cicatrix may easily be felt by introducing the finger between the lips, and it may readily enough be divided. But this mode of treatment of cicatrices, whether of the mouth or elsewhere, seldom answers its intended purpose. Again, the cicatrix may be dissected out; but another will form, probably harder and more dense than the first. These cicatrices, which result from ulceration and sloughing of the mucous membrane of the mouth, are always preceded by such an amount of painful inflammation that the masseter muscle becomes in a measure affected by it; and it consequently happens that long before the cicatrix has formed to impede the separation of the jaws, the child refuses to open its mouth, and keeps

it more or less locked. But this painful condition of the muscle results in structural shortening, so that after the cicatrix has been divided, the jaws can only be separated by further mechanical force.

Treatment.—The treatment in these cases consists, in the first place, of subcutaneous section of the masseter muscle; and secondly, of the application of the wedge. This being introduced between the teeth, may be acted on by means of a screw so as to separate the teeth and open the mouth. This is the principle of treatment which is applicable to cicatrices in general; namely, gradual extension. The treatment is necessarily slow. If it were otherwise the teeth would be loosened; and should this happen extension must cease. Should the cicatrix yield to gradual extension after section of the masseter muscle, contraction will probably not again take place.

Inflammation of the temporo-maxillary articulation may occasion either partial or complete ankylosis; the plastic matter which is deposited being converted into fibrous adhesions; or bony consolidation may take place.

The treatment of these affections of the jaw is greatly complicated by the circumstance of the articulation being surrounded and acted on by very powerful muscles, and also because these muscles—namely, the masseters, the pterygoids and the temporal muscles—are, perhaps, the last of the voluntary muscles to yield to the influence of chloroform, so that when they become relaxed, and the jaw drops, the patient will already have inhaled a very powerful dose of chloroform. It will readily

be understood how this difficulty is increased when inflammation has produced thickening of tissues, with adhesions. When the adhesions are recent, they yield to the long-continued use of the wedge, and the mouth may be opened to its fullest extent. It requires, however, a very long and persevering application of the same means to prevent contraction again taking place. When these measures fail, nothing is left but to divide the masseter subcutaneously, and again to extend gradually with the wedges as before.

When bony ankylosis has taken place, either by fusion, or by a bridge of bone extending from the lower maxilla to the temporal bone (for these osseous bands not unfrequently follow the course of the ligaments), it is necessary to divide the ramus of the jaw. Whenever it becomes necessary to divide the ramus care must be taken so to divide it that the false joint shall be formed in front of the impediment to motion, whatever this may be; otherwise the operation will be useless. When, however, the operator has the choice of position, it is well to select the sigmoid notch: less injury is inflicted in this position, and more power remains to the patient. Whether, however, this point be selected or not, a wedge of bone should always be removed, for in all operations on healthy bone there is a tendency to re-union when a simple section of the bone is made. This tendency is so strong that it is difficult to overcome it. Indeed, the strongest argument that can be used against the operation is this—that, notwithstanding the removal of a wedge of bone there is great tendency to bony re-union. I have only

once seen a case in which bony ankylosis had taken place simultaneously on both sides of the jaw. This resulted as a sequence of gonorrhœal rheumatism.

CHAPTER XI

TRUE ANKYLOSIS

Complete, bony, or true ankylosis is rare. When it has taken place, a sensation of solidity is communicated on grasping the limb above and below the articulation, such as can only be occasioned by continuity of bony structure. In fibrous ankylosis this sensation is never experienced. Fibrous ankylosis may, however, allow of so little motion that, with rigid muscles, it may be inappreciable, until chloroform has been inhaled. Therefore, as motion is thus masked, and as bony ankylosis is rare, it is safer not to express an opinion in favour of bony ankylosis until chloroform has been exhibited. When the patient is under the influence of chloroform, no doubt can exist as to the nature of the adhesions.

Bony ankylosis is the result of inflammation and suppuration within the joint. Destruction of the articular cartilages ensues; and ankylosis then results between the exposed surfaces of the bones, if the inflammation be of a reparative nature causing the deposition of new bone. When destructive inflammation ensues, causing necrosis of the epiphyses, bony union is impossible. Diseased action must cease before repair can commence; and bony union is repair. This repair, however, may be of such a

character as to be useless, and even worse than useless—it may be detrimental. Such cases then require surgical treatment.

Ankylosis is occasionally observed as a congenital affection : the articular apparatus is then entirely absent. But in these cases an inconvenient angle is never found, and the reparative process is as complete as nature can make it.

In bony ankylosis the articular extremities are either bound together in the course of the ligaments or the bones are united in their entire thickness—two becoming fused into one. It has occurred to me once to see a living person without a single movable articulation : every joint was ankylosed.

Bony ankylosis is, however, rare; but union may take place at such an angle as to be in the highest degree inconvenient. Under these circumstances this repair, which is intended to be permanent and useful, may fairly be made the subject of surgical interference.

Treatment.—There are four operations which may, under certain circumstances, be done, to restore motion or to improve the position of the limb—viz., 1st, to remove a wedge of bone; 2nd, to break through the ankylosis, after drilling through the new bony formation; 3rd, to make a false joint; 4th, to divide the bone subcutaneously, and restore the position of the limb.

1. It was proposed by Dr Barton of Philadelphia to remove a wedge of bone, when bony ankylosis had taken place with much deformity, and so to improve the position of the limb; and he performed this operation on the person of a young physician, whose

knee was ankylosed at a right angle. The following is his description of the operation:

"Two incisions were made over the femur, just above the patella. The first commenced at a point opposite the upper and anterior margin of the external condyle of the femur, and, passing obliquely across the front of the thigh, terminated on the inner side. The second incision commenced also on the outer side, about two inches and a half above the first, and, passing likewise obliquely across the thigh, terminated with the other in an acute angle. By these incisions were divided the integuments, the tendon of the extensor muscles of the leg, at its insertion into the upper part of the patella, and some of the contiguous fibres of the rectus and crureus muscles themselves, a greater part of the vastus internus, and a portion of the vastus externus. A flap composed, therefore, of this structure was elevated from the femur, close to the condyles. The soft parts were next detached from the outer side of the bone, from the base of the flap towards the ham, by passing the knife over the circumference of it, so as to admit of the use of the saw. The flap then being turned aside, a triangular or wedge-like piece of the femur was easily removed by means of a small, narrow-bladed saw. This wedge of bone did not include the entire diameter of the femur at the point of section; so that a few lines of the posterior portion of the shaft of the bone remained yet undivided. By slightly inclining the leg backwards these yielded, and the solution was complete."*

The limb was supported on a splint at an angle

* 'American Journal of Medical Sciences,' vol. xxi. 1837-8.

corresponding to that of the knee previous to the operation; and subsequently it was brought into nearly a straight position by using a series of splints with varying angles; until at length the limb could be confined in an extended position so long as it was necessary to produce bony union.

2. Professor Brainard, of Chicago, proposed subcutaneous drilling and subsequent fracture as a substitute for the operation of Barton; and the operation has succeeded perfectly in his hands, and also as it was performed by Professors Gross and Pancoast at the Jefferson Medical College. The mode of operation was as follows:

"Chloroform having been administered, a longitudinal incision, hardly one half of an inch in length, was made over the outer surface of the knee, near its middle, in a line with the groove between the head of the tibia and the external condyle, down to the two bones. Through this opening a steel perforator was introduced, keeping it as nearly as possible in the direction of the line of the articulation, and passing it on to the opposite side until the point could be felt beneath the integuments. The instrument was now moved about in such a manner as to cut through and break down the osseous adhesions between the femur and the tibia on the one hand, and the femur and patella on the other. The union between the bones was exceedingly firm; but, after much difficulty, it was finally overcome, and by forcible extension of the limb, the parts yielded with a cracking noise."*

* 'American Journal of Medical Sciences,' vol. lv. 1868.

NOTE.—In the 'Lancet' of April, 1876, this operation of subcuta-

When it is desired merely to gain a better position of the limb, one or other of these operations may be performed in cases where bony ankylosis with great deformity has taken place.

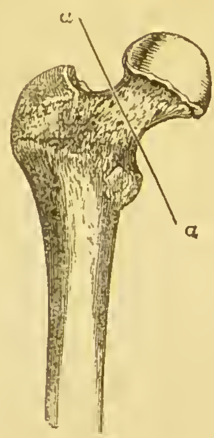
3. The third operation is that of establishing a false joint after section of the bone. This operation also was proposed and performed by Dr Barton of Philadelphia. Dr Barton's case was as follows :—Fracture of the femur had been followed by ankylosis at the hip-joint, and an angular union of the broken bone had resulted ; so that the thigh was flexed, and the knee was carried across the opposite thigh. Barton cut through the femur between the trochanters, and straightened the limb. The wound of the soft parts was allowed to heal, but re-union of the divided bone was prevented by subjecting it to motion from time to time—such as rotation, flexion and extension, abduction and adduction. After some few weeks the ends of the bones became smooth, rounded and united by means of ligamentous bands ; and thus an artificial joint was formed, which allowed of all the motions of the limb. This patient enjoyed the use of his artificial joint for six years ; but after this time he gradually lost motion, and ankylosis took place.

This operation of Barton's was an admirable one, and the result, so far as it went, was excellent. There was this defect in it, however—that the section of the bone was made too far away from the original centre of motion.

neous division of the uniting medium of the femur and the patella is claimed as a new operation, notwithstanding that it has been fully described and repeatedly performed during the last ten years.

When it is desired to re-establish motion in an ankylosed joint, the section should be made as near as possible to the centre of the articulation, so that the power of the muscles may not be unduly diminished. And with this view I operated, in 1861, with Dr Brown, on a case somewhat similar to Dr Barton's, where bony ankylosis was complete, but where there existed also some necrosed bone about the acetabulum. In this instance I cut through the neck of the femur immediately below the head of the bone, and then gouged away the remains of the head and the dead bone from the acetabulum. The line of the saw is shown in Fig. 48. The wound healed almost in its entire extent by the first intention, and in three weeks it was firmly cicatrised, so that passive motion could be freely employed. In six weeks from the operation our patient began to use the limb in walking. This patient was a delicate person, and had not sufficient fortitude to continue the treatment which is necessary in these cases to retain free motion.

Fig. 48.



In the next operation of this nature which I undertook, I operated with Dr Risk and removed the whole of the neck of the femur. In this instance there was no dead bone to remove and consequently it was not necessary to make so large an external opening as in the former case. The fibrous connecting bands which formed were somewhat longer and less firm, and from the commencement motion

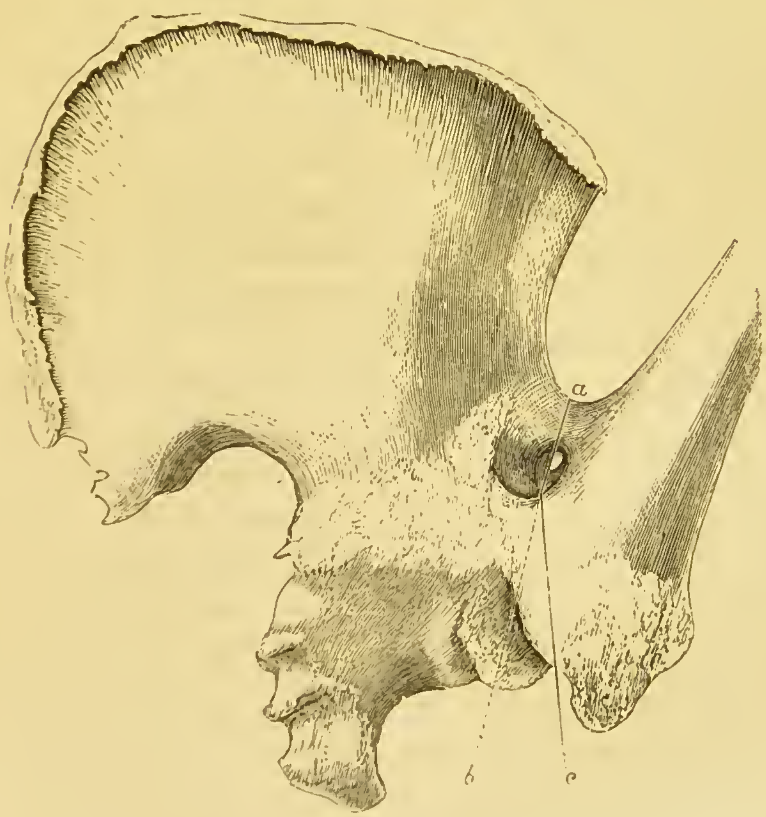
was more free than in the former ease. The patient also was in good health, and carried out with a strong will my injunetions with regard to motion. In these eases it is important to eontinue passive motions of the limb, otherwise shortening of the uniting medium, with more or less loss of motion, may take plaee. The incision in the skin did not exceed one inch and a quarter.

A ehronie form of inflammation may be set up after these operations, whether by aeeident or otherwise, which may result in loss of motion, just in the same manner as it may be set up in cases of fibrous ankylosis after motion has been perfeetly restored. Thus, in a ease on whieh I operated, in 1856, in eonjunetion with Sir Dunean Gibb and Dr Trouncer, motion at the hip-joint was perfeetly restored, and my patient eould walk easily, and without pain or unusual fatigue. He did not require a stick for support, and he habitually took much exercise. Motion at the operated joint was almost as free as in the other limb; but in 1867 he unfortunately fell on the ice and struek his hip, when inflammation followed, and tough adhesions were formed.

4. Where it is not desired to obtain motion, but only to rectify a false position of the limb, the bone may be divided subcutaneously, and an improved position may be given. I performed an operation of this charaeter, with the assistanee of Dr Riehard Brown and Mr Potter in 1865; and have subsequently had many opportunities of performing these operations of subeutaneous osteotomy. But, also, it may be neeessary in subcutaneous osteotomy to alter the direetion of the saw, before the section of

the bone is complete. Thus in an instance on which I operated in every respect similar to that from which the drawing was made, which represents ankylosis of the hip with the femur at an acute angle, and from which Fig. 49 was taken, it was necessary that a wedge-shaped piece of bone should be removed, so that all the advantages of the operation might be gained. Unless this were done the limb could not be extended, although the bony union might be divided.

FIG. 49.



So it was necessary to remove a wedge of bone, and to extend the opening from *b* to *c*, as is shown in the plate. The operation was not, however, less

subcutaneous in its character because the external wound was enlarged. If the bone to be operated on is not exposed, the operation remains strictly subcutaneous.*

Also in another case on which I operated later in the hospital, Ann B—, and in which the angle was somewhat similar to that represented in Fig. 49, the external incision was only large enough to admit the small saw. But whether osteotomy be subcutaneous or not does not depend entirely on the size of the wound. The wound, though comparatively large, may be so placed as to leave the operation subcutaneous. And the external wound should always be so placed that when the operation is complete it shall not correspond to the section of the bone. The results of these operations are frequently more favourable when the external opening is somewhat larger than when it is so small as to occasion bruising of the soft parts by the saw. Yet the external opening should not be larger than is necessary to admit the saw easily. There are cases of this description where it is necessary to remove portions of dead bone, and where consequently the external wound must be enlarged somewhat. More injury is done by bruising the soft structures than by making a free opening; and the character of the operation may remain exactly the same notwithstanding that the external wound be somewhat enlarged, so long as the parts to be divided are not exposed. If, for instance, the thigh is flexed upon

* The drawings from which Figs. 48 and 49 were taken were attached to a paper on this subject, which I read before the Royal Medical and Chirurgical Society in 1863.

the pelvis, as in the case now referred to, and it is proposed to divide the neck of the thigh-bone, the external incision should be made as much beyond the division in the bone as possible, so that not only do the wounds in the soft structures and in the bone not correspond, but when after division the limb is extended the wound in the skin shall really be remote from that in the bone.

Langenbeck introduced subcutaneous osteotomy; and Meyer and Bauer have practised it during the last eighteen years. This operation did not find favour in England, however; and it had I believe never been performed, except by myself, until 1871, when Mr Adams divided the neck of the femur.

At the hip a false joint should if possible be made; while at the elbow or at the knee a wedge of bone may be removed, or the ankylosis may be fractured after drilling through the bone.

CHAPTER XII

CONGENITAL DISLOCATIONS

These dislocations are found at birth, and are therefore termed congenital. They occur especially at the hip-joint. Other dislocations also occur, but they are subluxations rather than true dislocations; and they are found together with monstrosity, paralysis, and idiocy, and also with alterations of the articular surfaces. In this manner, the shoulder, the knee, the elbow, the wrist, and the jaw are found in such cases to be luxated. Congenital dislocations of the shoulder, for instance, are partial displacements of the head of the humerus, simulating more or less true dislocation, with complete or partial paralysis of the muscles around the articulation; while those of the elbow and the wrist are always associated with malformation or monstrosity, and they are produced by muscular retraction. Congenital dislocations of the knee are subluxations, which are to be treated by extension of the limb after subcutaneous section of the hamstring tendons. Thus, other forms of congenital dislocation occur together with anomalies of organisation, or they occur together with paralysis, or they are subluxations. But the dislocations of which I will treat, at present, are those of the hip-joint.

These congenital dislocations of the head of the femur occur in three directions—namely, upwards and outwards, directly upwards, and upwards and forwards; but the first-mentioned variety, or that upwards and outwards, alone requires attention at this time, the other two forms of dislocation having only been seen in fœtal monstrosities.

Dislocation of the head of the femur upwards and outwards, on to the dorsum of the ilium, occurs for the most part on both sides simultaneously; and it occurs more frequently in the female than in the male child. Thus, Dupuytren mentions that, in the course of twenty years, he saw twenty-six instances of congenital dislocation of the femur, twenty-two of which occurred in female children, and only four in males; and that, with two or three exceptions only, all of these were instances of double luxation. I have had thirty-four cases of congenital dislocation of the hip under my care, twenty-six of which have occurred in female children, and eight in males. In two boys and seven girls, the dislocation was single: in the remaining twenty-five the dislocation was alike on both sides.

Causes.—It has long been a question how this form of dislocation is occasioned. Some, as Dupuytren, believed it to be caused by defective organisation in the germ; while others, as Guérin, believe that active muscular spasmodic retraction causes not only congenital dislocations, but also all other congenital articular deformities. And Carnochan expresses a similar notion in the following words:—"Congenital displacements occurring at the ilio-femoral articulation result from active morbid mus-

cular retraction." I would place a single fact against this theory of M. Guérin's—namely, that in the cases of congenital dislocation of the head of the femur which I have seen, there has never been present spasmodic action of any muscle or set of muscles, whether of the muscles of the hip or elsewhere; nor have I ever known in these cases difficulty in guiding the limbs through disturbed nervous action. And therefore I cannot believe, with Carnochan, that "a pathological spasmodic retraction of the muscular tissue, resulting from a perverted or disturbed condition of the excito-motor apparatus of the medulla spinalis," is the cause of congenital dislocation. So far from any disturbance of the nervous system existing in these children, they are for the most part healthy; and I am unable to call to mind an instance of unusually delicate health in any child whom I may have seen affected with congenital dislocation of the hip.

The cause of congenital dislocation of the hip, as it usually presents itself, is a purely mechanical cause. This dislocation never occurs except with a preternatural labour, and it occurs especially with a presentation of the nates. When the breech presents, the child passes through the pelvis with the legs doubled up, and the feet towards the thorax. The blunt hook, or the finger, is sometimes used to assist the passage of the child; and for the sake of traction it is necessarily placed, when employed, at the top of the thigh. But, when the thighs are flexed upon the abdomen, the heads of the thigh-bones must press against the posterior and inferior portions of the capsule of the joint; so that traction

in this position will readily cause the head of the bone to escape from its shallow acetabulum.*

Some very rare instances of congenital dislocation have occurred where the head of the femur was misformed and the cavity of the acetabulum imperfectly developed; where also other deficiencies and abnormalities existed. Such cases are referred to by Cruveilhier, von Ammon, and others. But these cases have little in common with those to which I am now alluding; for in all cases of this class the children are healthy, and they are well-developed and well-nourished.

Symptoms.—The symptoms of this dislocation vary with age. At birth it passes unobserved. When the child is lying down, the head of the femur is only slightly prominent: it may be felt, however, on rotating the limb. In the erect posture, the head of the bone becomes prominent, and presents visibly on the dorsum of the ilium above and behind the cotyloid cavity.

When dislocation of both thigh-bones has taken place, the pelvis is rendered very oblique, and the sacrum is raised; so that the abdomen is rendered prominent, and the lumbar region becomes remarkably hollow. The trochanters project unusually,

* It is beyond doubt that this dislocation is produced at birth through downward force applied to the thigh in endeavouring to hasten the birth in breech presentations. A slight click is heard while pressure is being applied, and at the same moment the head of the bone passes out of the acetabulum. I lately saw a family of three children, one of whom had congenital dislocation of the right femur; another had congenital dislocation of the left femur and congenital talipes varus; and the third suffered from congenital dislocation of the heads of both thigh-bones.

and are placed nearer to the crests of the ilia than is natural; and the heads of the thigh-bones are to be seen projecting on the ilia, beneath the glutei (Fig. 50). The muscles of the dislocated limb remain small, from insufficient use; but children who are thus affected are tolerably active, and can move

Fig. 50.

about rapidly and without pain. There is always also more or less genu valgum and flat foot. The motion of these children in walking is very peculiar: it is, when both bones are dislocated, a rolling motion of the trunk, with more or less apparent insecurity or lameness. When the head of one femur is alone dislocated, the limb is shortened, so that the heel does not rest on the ground, and there is considerable weakness and yielding of the limb in walking; but the obliquity of the pelvis is less than when both bones are dislocated.

In the erect position the lumbar curve is very considerable; but it is in great measure effaced in the recumbent posture. Whilst the child is recumbent the head of the bone may be drawn down upon the acetabulum, and the length of the limb may be thus restored.

Pathological Anatomy.—At birth the acetabulum is, I believe, never altered (in the cases of which I am now speaking—namely, those of dislocation upwards and outwards, and where there is no other abnormality present), in shape or dimensions, and the head of the femur retains its normal appearance. Changes, however, subsequently take place, both in the cotyloid cavity and in the head of the bone, for the cartilage wastes and the cavity becomes partially filled up with cellulo-osseous material, while the head of the bone becomes at length somewhat irregular in shape, and its cartilage is thinned. The capsular ligament retains its integrity for some years: it becomes elongated; and as the head of the bone at length escapes through its capsule, the ligamentum teres, being stretched, becomes slender

and finally gives way; so that the head of the bone comes into direct contact with the ilium. When the head of the bone passes through its capsule a false articulation commences to be formed. Thickening of the cellular tissue with deposit of lymph takes place, which is ultimately developed into a new capsule, while a cavity is formed to receive the head of the bone by the deposition of osseous matter upon the ilium.

Treatment.—When dislocation occurs without other abnormality, both the acetabulum and the head of the thigh-bone are usually perfect at birth. There would then be neither difficulty in reducing the dislocation, nor in retaining the head of the bone in the acetabulum. The dislocation, however, is overlooked at birth, for the obvious reason that it is not suspected; and when it is discovered—probably after months and years have elapsed—changes have already taken place which tend to impede the reduction, and which prevent the head of the bone being retained in the acetabulum. Absorption of the head of the bone proceeds at the same time that the acetabulum is being filled up, while the tissues around the head and neck of the bone are undergoing degeneration—those which are stretched undergoing fibrous degeneration; those which are relaxed becoming weak and fatty, and those which are much exerted, hypertrophied.

At birth the diagnosis can only present any difficulty when the luxation is double; for when it is single the difference in the length and direction of the limbs, and especially the difference which must exist on the two sides of the pelvis, can scarcely fail

to discover the dislocation. For the most part, however, the dislocation is only suspected when the child begins to walk, and indeed it is often overlooked for years; but the peculiar gait—the lameness when the dislocation is single, and the rolling movement when both thigh-bones are displaced, is then certain to attract attention. All the peculiarities of this dislocation are exaggerated when the patient is standing, and especially in walking; while, on the other hand, they are much diminished in the recumbent posture. It is for this reason that congenital dislocation of the femur is seldom discovered until the child begins to walk alone: then the peculiar gait attracts attention.

The peculiarities of this dislocation were very strongly marked in a boy lately in the Grosvenor ward. In this case both limbs were dislocated, and the trochanters projected abnormally and approached nearer to the crests of the ilia than in their natural condition, and the heads of the thigh-bones were seen projecting on the ilia beneath the glutei. The pelvis was thus rendered very oblique, the sacrum being raised and the pubes carried backwards, while the lumbar and the lower dorsal vertebræ were curved forward, rendering the abdomen protuberant. The knees, in these cases, are directed inwards, and the feet are flat. The lower limbs are weak and they are wanting in muscular development; while the arms and the muscles of the upper part of the trunk are largely developed, and they are much used in progression. This boy was twelve years of age, and the changes to which I have referred had already taken place in him, so that the head of the bone was

more or less fixed in its new cavity. But before this period has arrived, and while the cartilaginous surfaces retain their integrity, the dislocation may be reduced, and the head of the bone may be retained in the acetabulum. It is probable that until muscular retraction has taken place, this replacement may always be effected by manipulation under chloroform, and that the head of the bone may be retained in the acetabulum with the help of bandages and splints ; but when retraction of the powerful muscles about the neck of the bone has taken place, although the dislocation may be reduced under chloroform, these muscles again displace the bone. These considerations induced me to propose the subcutaneous section of the muscles which are inserted into the trochanter.

It must be borne in mind that there is no difficulty, even after some years have elapsed, in restoring the length of the limb, by drawing down the head of the femur to rest on the acetabulum ; but there is great difficulty in retaining the head of the bone in that position. I therefore resolved to divide subcutaneously those muscles which tend to displace the bone—namely, those which are inserted into and about the trochanters, especially the glutei and the rotators ; and I found that, when the head of the femur was drawn down to the acetabulum, these muscles having been divided, it remained in that position and did not undergo displacement, even though retentive appliances were not immediately used.

On the 21st March, 1865, I first performed this operation. I had been consulted by Mr Herbert

Barnes respecting a case of congenital dislocation of the head of the femur some months previously, when I proposed the operation to which allusion has been made; but it was not at first acceded to. Extension, as recommended by Pravaz and Gillebert d'Hercourt, was therefore employed for many months, but without any real advantage being gained; and consequently it was determined to resort to operation.

With the assistance of Mr Holmes I divided all the muscles which are inserted into and about the trochanters, especially the glutei and the rotators. The head of the femur was then drawn down to the acetabulum, and it was found that it remained in that position, and that there was no disposition to displacement. The limb was bandaged to a straight thigh-splint, and sufficient extension was employed to keep the head of the femur in contact with the acetabulum. This was easily effected, there being no disposition to retraction. In two months after the operation consolidation had advanced about the joint so thoroughly that the head of the bone did not escape from the acetabulum, but remained perfectly *in situ* while passive motion was employed. After this time the natural motion of the hip-joint was imitated daily for one month; and the child was then allowed to walk having an instrument applied, which was so contrived as to support the head of the bone in the acetabulum, but which at the same time allowed the movements of the limb to be free. This instrument was worn during the day for six months. After this time it was not worn constantly; and at the end of twelve months it was discontinued. At that time

the child walked strongly and without limping; and indeed there was scarcely any peculiarity of gait. She required no other assistance than a thickened sole to her boot, to the extent of about one eighth of an inch, to enable her to walk well.*

This, then, is the operation which is applicable in these cases, and from which I have derived in several instances excellent results.

After the section is complete the limb should be fixed to a straight thigh splint, or extension may be kept up with pulleys and weights; and after an interval of six weeks or two months passive motion may be employed. After this time consolidation will have taken place about the head of the bone sufficient to prevent displacement. It is desirable however to continue the use of a retentive apparatus for many months.

Another case of this description on which I operated was that of a boy four years of age, whose right femur was dislocated. This child walked with help and a sustaining apparatus in the course of six months; and in the seventh month he could walk without his apparatus and without any displacement of the head of the femur occurring; but the limb was still weak and required support. When he was lying down, he had complete control over the limb, and could move it in every direction.

In children under two years of age it will probably not be necessary to have recourse to this operation, for the head of the bone will probably be retained after replacement, and with-

* 'St George's Hospital Reports.' vol. i.

out subcutaneous section; but after this age, displacements will scarcely be prevented without operation.*

* For further information on this part of the subject, I will refer to the article on "Congenital Dislocations," in Holmes's 'System of Surgery.'

CHAPTER XIII

OLD UNREDUCED DISLOCATIONS

Since chloroform has been in use we have been compelled to modify our opinions on various questions of operative surgery, and especially so in those cases where it is necessary to overcome the influence of the muscles ; as, for instance, in the reduction of dislocations.

Before chloroform was in use, it was held to be a surgical law that in dislocations of the hip attempts at reduction should not be made after eight weeks of displacement, and in dislocations of the shoulder the limit was fixed at three months.

Now, however, these periods may fairly be greatly extended. When dislocation has occurred and the capsule is rent, inflammatory thickening takes place around the extremity of the displaced bone, adhesions form, and ultimately a new capsule is developed, the surrounding cellular tissue becoming condensed. In the orbicular joints especially, motion is easily established, and the new capsule becomes perfected through motion : it is furnished with a smooth lubricating lining, and in many instances free motion is in time permitted. Also a cavity is formed to receive the head of the bone. If the head rests on muscle, the muscle becomes dense and is hollowed out for

its reception; but if it rests on bone a cavity is formed to receive it, in part by absorption of the old bone, such as the ilium or the scapula, in part, also, by the deposition of new bone; and this is at length lined either by ligamentous substance or by a smooth porcellanous deposit. But, on the other hand, the head of the bone may be displaced in such a manner as to press on neighbouring vessels and nerves, so that not only is motion painful, but it may be so painful that it cannot be borne; and, in such a position the pressure of the head of the bone, even while at rest, causes in many instances more or less constant pain. So long as it is necessary to keep the limb at rest a new joint cannot be formed, for motion is absolutely necessary not only for the perfection of the new articulation, but also for its development.

Thus, in old unreduced dislocations two distinct conditions are to be observed. On the one hand, nature remedies the effects of a dislocation by the development of a new joint; while, on the other hand, adhesions form around the head of the bone and consolidation takes place. These tend to fix the limb and prevent painful motion. In the former case the limb daily gains strength as the new joint becomes more perfect; while in the latter, atrophy of the limb results.

Treatment.—In the treatment of old unreduced dislocations, with the advantage which chloroform gives us, the amount or absence of repair should therefore be considered, rather than the length of time during which the limb has suffered displacement; for although it may remain a question for the operator to

determine whether it is desirable to attempt the reduction of a limb which is regaining power and motion, it will be generally admitted that it is right to make every feasible attempt to reduce a dislocation where the limb remains motionless or painful.

These questions of motion and pain may fairly be allowed to guide us in every instance of this description where we are called upon to decide on the feasibility of an operation for reduction; for when the limb has not been used, but has remained motionless, very slight change will have taken place in the articular surfaces, so that it is difficult to fix a limit to the period at which it could truthfully be said that such an operation would not under these circumstances be justifiable. The health and the age of the patient are questions to be considered, not alone before performing such an operation, but also in every operation in surgery ; and therefore these questions will of course be considered by every prudent surgeon before he determines to reduce an old dislocation. When it is remembered that the acetabulum may retain its form and its depth together with the cartilage, after the head of the femur has been dislocated for thirteen years, it will be understood that it is difficult to assign a limit to these operations. Fournier has placed on record a dissection where the head of the femur had been dislocated during thirteen years, and where the acetabulum retained its form and its depth and cartilage.*

After the patient has been placed fully under the influence of chloroform, so that muscular resistance has entirely ceased, the adhesions which have formed

* 'Bulletins de la Société Anatomique,' 1855.

around the head of the bone are to be broken up by free motions of the limb—to-and-fro motions and motions of rotation—which shall leave the head of the bone free and movable. The adhesions are thus to be broken through by applying moderate force only. Immoderate violence can never be justifiable. When the head of the bone is entirely loosened from its attachments, the limb is to be so manipulated that the head of the bone is drawn towards or carried into its articular cavity; and there it is to be immediately fixed by appropriate bandages, lest it should again slip out. I have seldom known even the head of the humerus again to become displaced after the limb had been bandaged and efficiently supported by pads in the axilla.

Some time ago I saw, with Mr Chalk, a patient, fifty-three years of age, who had fallen from a height of twenty feet and had thus dislocated the humerus beneath the pectoral muscle. The swelling was considerable at the time, so that the dislocation was not discovered by the surgeon who first saw this patient; but afterwards an attempt at reduction was made, which, however, was not successful. Four months later he presented himself at a large metropolitan hospital, that an attempt at reduction might be made. He was persuaded, however, not to submit to any attempt to replace the head of the bone. Two months after this I saw him. He was suffering acutely, and was unable to move the limb or to carry it without support. Any attempt at motion caused excessive pain, especially about the neck of the humerus and at the elbow.

The head of the humerus could be distinctly felt lying beneath the pectoral muscle, where it appeared to be firmly fixed. The deltoid, the biceps, and the pectoral muscles especially were atrophied; but also the whole limb was wasted. The fingers were numb. The elbow was somewhat removed from the side, and was inclined backwards, where it was fixed and immovable; the forearm was flexed, and the hand was carried forwards.

Under these circumstances we determined to endeavour to replace the head of the bone; and although the humerus had been dislocated for 175 days, we considered ourselves justified in making the attempt at reduction. The patient was therefore placed sufficiently under the influence of chloroform, and the scapula was firmly fixed both laterally and from above. The adhesions about the head of the humerus were then broken up by to-and-fro movements of the humerus and by freely rotating the head of the bone. Then grasping the wrist, I drew the arm directly upwards, when the head of the humerus immediately slipped into the glenoid cavity with a slight click. A pad was placed in the axilla, and the arm was bandaged to the side. The patient remained in bed for three days, and on the sixth day the bandages were removed, and gentle motion was commenced. There was no disposition at any time for the bone again to become displaced.

After some considerable time the power of motion was in great measure, if not entirely, restored; pain and numbness ceased, and there was no difference in the fulness of the two shoulders; so that when I last saw him this arm was almost as useful as the other.

When pain has subsided, passive motion may commence: perhaps after ten days or a fortnight shall have elapsed.

In some cases of old dislocation it may be necessary to divide the tendons of retracted muscles before attempts at reduction are made. This was done in the following case.

Elizabeth C—, nineteen years of age, was admitted into the hospital on the 8th of July, 1868, with an old dislocation of the wrist forwards. This dislocation resulted from a fall on to the palmar surface of the extended fingers; and it occurred six years before her admission into the hospital. All power of motion was entirely lost in the wrist and in the fingers. On the day after her admission into the hospital I divided the flexor tendons subcutaneously, namely, those of flexor carpi radialis, palmaris longus, flexor sublimis, and flexor carpi ulnaris; and four or five days later, the punctures having healed, chloroform was administered, the adhesions were ruptured, and the hand was restored to its normal position by flexing and subsequently extending the hand upon the forearm. The limb was then laid upon a straight splint and firmly bandaged to it. After some few days passive motion was commenced; and for this purpose an instrument was constructed with a joint corresponding to the wrist-joint, which supported the extremities of the radius and ulna and the carpus, and which allowed of motion without displacement of the wrist.

This patient regained entirely the use of her hand and wrist, and was able again to follow her

occupation in the same manner as before the accident.

In these cases, then, of old dislocation, attempts at reduction may be made so long as the limb remains painful or motionless; and when considerable muscular retraction has taken place the tendons of the retracted muscles should be divided, and the punctures having healed, the adhesions are to be broken through and the limb is to be replaced in its normal position.

CHAPTER XIV

CONTRACTED CICATRICES

I HAVE had occasion in Chapter X to allude to cicatrices of the mouth; and I have also had occasion to allude to cicatrices from burns and from lacerated wounds.

If it is extremely difficult to prevent contraction of cicatrices such as these, it must notwithstanding be confessed that many of these contractions result from want of ordinary care during the healing process, and especially after cicatrisation is complete or nearly complete.

These contractions occur especially in the regions of the neck and the axilla. They are met with, however, affecting the flexures of the joints, whether the elbow, the wrist and hand, the knee or the foot. The neck and the axilla, however, are more frequently the seats of cicatrices from burns than are any other of the regions of the body, these parts not only being more exposed to the rising flames when the clothes catch fire, but also there occurs in these situations a deeper destruction of tissue through the long continuance of the action of fire than is found elsewhere.

Thus, through the destruction of the integument of the neck, the entire surface of the front of the

neck may be exposed, and a contractile cicatrix will form drawing down the chin upon the thorax. Then the lip becomes everted, and its red edge may be united to and blended with the cicatrix. Under these circumstances the saliva cannot be retained, but it dribbles from the mouth ; and the teeth, being unsupported by the lip, fall outwards, and at length becoming loose are eventually detached. Then also, although the face itself may not have been touched by fire, the contracting cicatrix having drawn down the angles of the mouth, the eyelids eventually become everted, and the eyeballs remain uncovered.

In the axilla the contracted cicatrix may bind the arm so firmly to the side as to prevent entirely the motions of the arm. I have known the web to extend to the elbow. And in the same manner wherever the flexures of joints have been injured by the action of fire, contraction of the cicatrix may take place so as to produce deformity of the limb, or even dislocation of the smaller joints.

In the flexures of the larger joints the tendons become contracted together with the fascia and the subcutaneous structures; but this depends on the depth of the burn : the superficial layers of the skin may alone be injured, and then cicatrisation is completed without deformity being produced; but, on the other hand, when the skin is destroyed in its entire thickness, contraction takes place during the process of cicatrisation and after cicatrisation is complete.

Treatment.—The period at which the treatment of these accidents is undertaken is an important element in the consideration of the case, and of the mode of

treatment to be adopted. Further, the treatment must differ somewhat according as the burn is superficial, or as it involves the deep structures. A recent cicatrix is comparatively more extensible than one which has existed for many months; and the cicatrix may consist of integument only, or there may be involved powerful tendons together with it.

The modes of treatment vary, then, not only according to the region which is affected, but also as the duration of the cicatrix and the depth of the burn vary.

The modes of treatment are, first, gradual and constant extension; second, extension by passive movements; third, the clamp; fourth, division of the cicatrix and the introduction of a flap of sound skin; fifth, division of the cicatrix and replacement of the parts in their normal positions and the subsequent engrafting of portions of skin.

1. The rack-and-pinion movement for extension is applicable in all cases where the extending apparatus can be firmly and steadily fixed. Such instruments may be employed to extend cicatrices which have formed in the region of the neck and which tend to bind down the chin to the sternum.

Whatever may be the shape of the apparatus to be employed, care should be taken to moderate the pressure which may be used, so that sores may not be formed; for a cicatrix can only be extended slowly. Rapid movements cannot be borne; but they will be followed by inflammation and by the speedy destruction of the lowly organised tissue.

Wherever instruments can be accurately fitted to the affected parts, such as the arm and forearm, the

leg and thigh, the fingers, &c., gradual extension may be employed advantageously.

In this manner the contraction which is represented in Fig. 51 was overcome. Here was a rec-

Fig. 51.

tangular contraction, which had existed for eighteen months in a young person nineteen years of age. In the course of four months the web was entirely removed by means of gradual extension, and the motions of flexion, extension, and rotation were perfectly restored. Not only was the web removed, but the skin of the arm, which previously was puckered and rough, became smooth and even.

When extension of the web has been accomplished by the means above detailed or by passive motion, contraction never again takes place.

When contraction has taken place in the hand, and the fingers are drawn down more or less into the palm, the palmar fascia and the subcutaneous tissues being thickened, hardened and contracted, with, perhaps, loss of substance, extension becomes, not only extremely difficult, but the treatment is fre-

quently unsatisfactory. Then it is perhaps necessary to divide tendons and processes of fascia before extension can be adequately undertaken.

The same course of treatment should be adopted at the elbow and at the knee, and, indeed, wherever tendons are shortened, or wherever, by their contracted condition, they tend to impede the progress of extension. Whatever may tend to facilitate the extending process recommends itself very strongly for adoption in the treatment of contracted cicatrices, and nothing facilitates the process of extension where structural shortening has taken place more than the subcutaneous section of the tendons involved in or connected with the cicatrix.

2. Extension by passive movements is especially applicable after contraction in the axilla has taken place, when the cicatrix is recent. In this situation the powerful leverage which is afforded permits of the adoption of passive movements with remarkable effect.

Lately there was a patient under my care in the Hospital, sixty years of age, who had been extensively burnt on the back and breast and in the axilla, and in whom, when she presented herself at the hospital, cicatrisation had taken place over the entire surface, with the exception of a space on the back equal to the palm of a man's hand. The arm was bound firmly to the side, and could not be raised away from the side; but as the cicatrix was recent it appeared to me a favorable case for the employment of passive movements, and I therefore directed that they should be used daily.

At first the hand alone was used to raise the

patient's arm, the shoulder being at the same time securely fixed with the other hand. Gradually the dense web yielded and a greater range of motion was gained. A pulley and weights were then so arranged that as much force as could easily be borne should be applied; and thus the cicatrix gradually yielded and the web was at length entirely removed; so that motion at the shoulder-joint was restored as perfectly as before the accident.

Passive movements may also be employed at the elbow- and at the knee-joints; but they are especially applicable to contractions in the axilla.

3. But there are cases in which neither of the foregoing modes of treatment are applicable, but in which a clamp may be employed with advantage. The web at its root is to be punctured with a barbed screw, which carries one arm of the clamp; and the sharp point being removed, the upper portion of the clamp is to be placed upon the web and tightened by means of the screw. A slough is thus produced; and the metal being withdrawn, and the slough having separated, a piece of oiled lint is to be introduced into the wound to promote cicatrisation of the edges of the wound. This being accomplished, the remainder of the web is to be divided from the aperture to the free edge. The cut edges are then to be dressed and kept asunder; and where it is necessary, gradual extension is at the same time to be made to restore the normal position of the limb.

This mode of treatment has been in vogue for many years for webbed fingers. It was first introduced in the year 1861, in a case on which I operated

together with Dr Forester; and the principle, with a slight modification of the instrument, was afterwards adapted by the late Mr Tamplin to the contracted cicatrix of a burn, and by Mr. W. Adams in 1868 to a very extensive web, which reached from the knee to the foot, distorting the foot. In such cases this treatment is attended with very great success. But the principle of this operation dates farther back than 1861; for the operation was proposed by Mr Liston, though he never performed it. He says, "I have thought of making a perforation through the web towards the proximal extremity of the finger, and by the introduction of some foreign body, as a piece of thick firm cord, preventing its healing: after the edges have cicatrised, then the remainder of the web might be cut at one sweep, and the fingers dressed separately for a sufficient time."*

Congenital union of the fingers and of the toes may be by folds of skin only, or there may be union of the bones as well as of the soft textures. Again, the web may be partial only or complete. When two nails are fused with a deep sulcus in the midst, as frequently obtains, the bones of the distal phalanges are also united and require to be divided. But whether the web is complete or partial only the treatment is the same, namely, to puncture the web at the proximal end, and cicatrisation having taken place, the remainder of the web is then to be divided.

4. When the chin, for instance, is so bound down by the cicatrix that it is impossible to fix an extending instrument to the jaw, when, in fact, gradual extension of the cicatrix is impracticable, the cicatrix, or such

* 'Practical Surgery,' p. 571.

parts as shall liberate it, may be divided across and flaps of healthy skin be implanted in the gap. If the adhesion of the transplanted flap could be secured, this operation would be highly commendable; but, inasmuch as this is seldom the case, the flap sloughing in a large number of instances, entirely or in part, this is an operation to which recourse should only be had as a last resource.

5. Having divided the cicatrix or the skin in such a manner as to liberate the parts affected, as in the last-mentioned case, the jaw for instance may be raised to its normal position, and there held by a suitable instrument; and when the exposed surface is covered with healthy granulations, portions of skin may be engrafted on the surface after the method of Reverdin.

I have operated several times after this manner, and the result has invariably been so good, that I do not hesitate to recommend it for adoption.

The first operation of this kind which I performed was done on a child six years of age, whose chin was bound down to the sternum. The cicatrix had existed for fourteen months, and it was both tense and hard. Having divided it across, the chin and sternum being held well asunder, I introduced, on the fifth day after the operation, three small portions of skin, each about the size of a threepenny piece, from the side of the neck on to the granulating surface. They were covered with lint, and not disturbed for four days. Cicatrisation went on rapidly from these points, and the whole wound was nearly filled up in the course of three weeks.

It would be impossible that anything should have

succeeded better than the engrafting process as it was carried out in the instance above mentioned; but it cannot always be relied on to an equal extent.

Such, then, are the modes of operating in these cases according to the position and the degree of contraction, and the view of the operator.

PART III

DEFORMITIES OF THE TRUNK AND NECK

CHAPTER XV

CURVATURES OF THE SPINE

Curvatures of the spine are met with, especially, in three varieties—namely, anterior, posterior and lateral curvature.

The antero-posterior pathological curves are, for the most part, merely exaggerated conditions of the physiological curves. Thus we find anterior curvature existing especially in the lumbar region, and posterior curvature in the dorsal region. It will be shown farther on, however, that these conditions are not absolutely limited to a given region; but that the vertebræ above and below may be involved in the curve, so as to reverse the normal curve of any region. These curves are rarely congenital; but they are for the most part induced through ignorance or neglect on the part of the nurse, or through deficient nutrition.

Before proceeding to consider these pathological

conditions, however, it may be desirable to examine the normal—physiological—curves of the spinal column, as they occur in the *fœtus in utero*, after birth, and in the adult; and to consider very briefly their formation and their purposes.

NORMAL OR PHYSIOLOGICAL ANTERO-POSTERIOR SPINAL CURVES

The spine in the fœtus is bent forward; its curve being moulded by the walls of the uterus: the head is bent upon the breast, and the thighs are folded upon the abdomen.

In the infant, the spine remains almost straight while in the horizontal position. The sacrum is only slightly curved, and the pelvis is more oblique than in the adult.

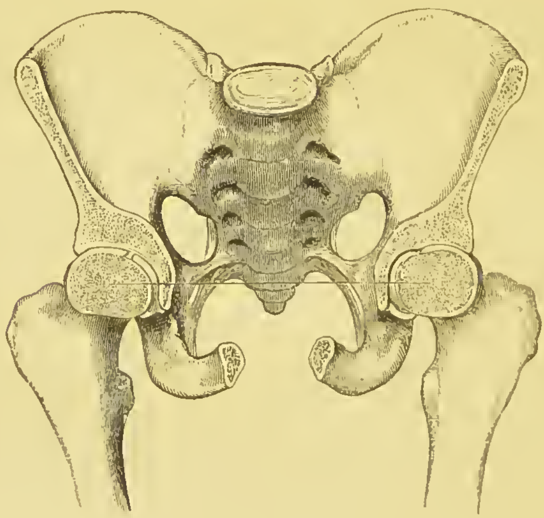
The normal—antero-posterior—curves are developed slowly, and depend in great measure on muscular action and on the erect position which man is destined to assume. At birth these curves do not exist; and even in the young child they are not constant, for they disappear when the horizontal position is resumed. Gradually, however, the antero-posterior curves become more or less permanent; and, before growth is complete, the spine is found to have gained, as a constant condition, lumbar, dorsal, and cervical curves; while, on the other hand, it has lost much of its flexibility.

On examining carefully the spinal column of the adult in the erect position, it will be seen that the

base of the sacrum is so placed that it is to be found immediately above a straight line which may be supposed to pass through the heads of the thigh-bones, and which is known as the interfemoral line. This is shown in the following figure (Fig. 52). The fact was demonstrated by MM. Weber.

Naegele first showed exactly the position of the pelvis in the upright posture. Prior to his demonstration of the fact, it was believed that the pelvis was

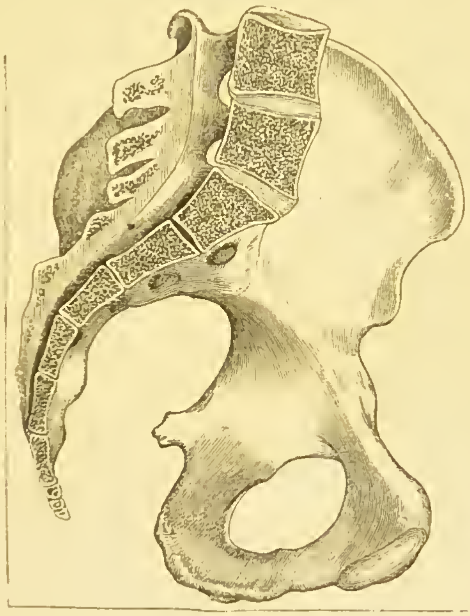
FIG. 52.



more horizontal than is absolutely the case. The pelvis is so oblique that the anterior wall (pubes) presents upwards and backwards, and the posterior wall (sacrum and coccyx) downwards and forwards, as is shown in Fig. 53. Such, then, being the positions of the pelvis and of the sacro-lumbar articulation, the question arises, how is equilibrium maintained?

Equilibrium is the result of certain forces acting in front of and behind the spinal column; namely, the action of the flexors and the extensors of the trunk, neck and head, and the resistance of the ligaments that hold together the several vertebræ which form the spinal column. In the erect posture these structures combine to poise the head and the

Fig. 53.



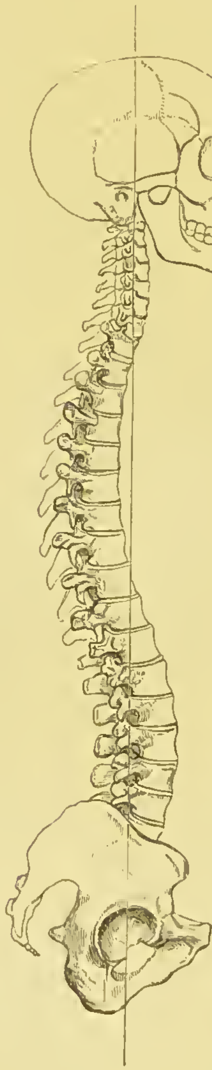
vertebral column in the vertical line on the heads of the thigh-bones. (See Fig. 54.)

In considering this question, the weight of the viscera should not be forgotten. At the present time, however, the chief points alone can be taken into consideration.

The position of the sacro-vertebral articulation being, then, such as has been described, it becomes necessary for the maintenance of equilibrium, and that the head may be poised (its centre of gravity

corresponding with a vertical line which coincides with the axis of the trunk, and which shall fall on

Fig. 54.



the interfemoral line), *first, that the lumbar vertebræ shall be curved backwards.* This lumbar curve is the

result of muscular action in the endeavour to maintain the erect position. It is the reverse of the sacral curve; and it springs from the sacro-lumbar articulation upwards and backwards, the sacral curve commencing at the same articulation, and presenting downwards and forwards. When a curve has been formed, it is essential that a second curve—dorsal—shall restore the direction of the spine towards the perpendicular line; and, for a similar reason, a cervical curve is formed in the same direction as the lumbar curve. These several portions of the spine differ somewhat in flexibility, the lumbar and the dorsal portions possessing this quality very nearly in equal degrees; but in the cervical region the flexibility is three times greater than in either of the other regions. Thus, a structure is composed of segments of various circles, strong, yet elastic, fitted to bear the superincumbent weight, and yet capable of resisting the effects of shock.

It would, perhaps, be impossible to imagine a structure more perfectly adapted to its purposes than the spinal column, formed as it is of separate pieces, which are severally united by discs of fibro-cartilage, bound together by numerous and strong ligaments, and surrounded and acted on by powerful muscles. Its flexibility and its curved form are points of even, perhaps, more importance than its great strength: these adapt the spine specially to its purposes.

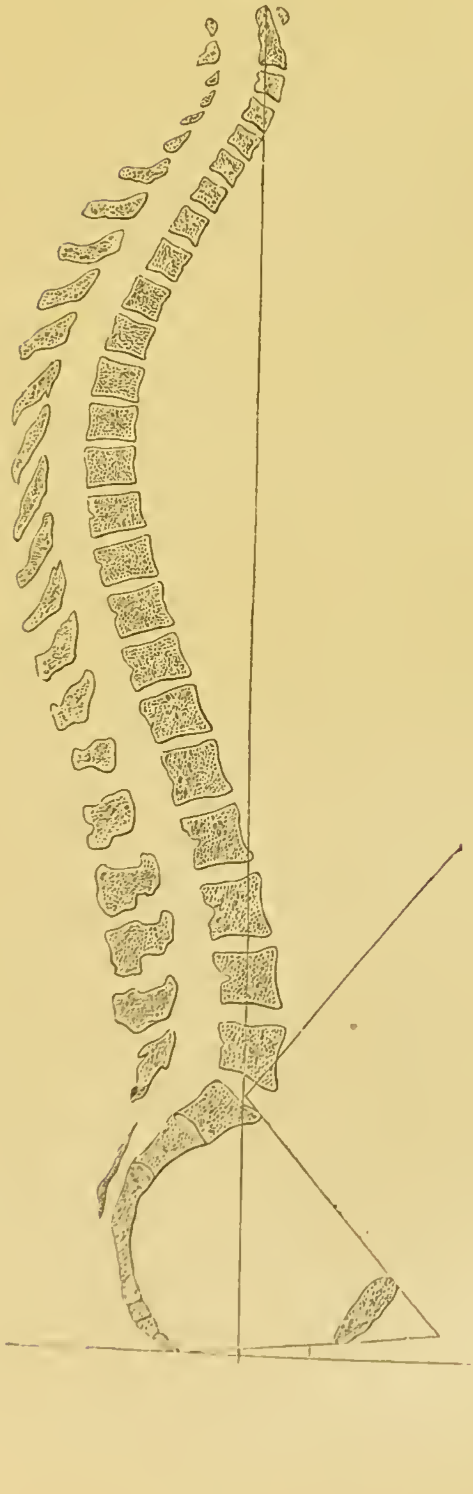
I do not desire in this place to enter minutely into questions of physiology, and will therefore only allude to the opinions of some eminent physio-

logists, such as the Webers, Cruveilhier, Bishop, and others, who have stated their belief that the normal curves of the spine depend on varying thicknesses of the bodies of the vertebræ and of the intervertebral substances. It is true, as the Webers have shown, that, in the dorsal region of the spine especially, differences in thickness exist on the anterior and on the posterior surfaces of the vertebræ; namely, that on their anterior surfaces, in the concavity of the curve, the vertebræ are somewhat thinner than they are posteriorly; while in the lumbar and in the cervical regions the fibro-cartilages are especially affected, being compressed posteriorly.

To show the varying thicknesses of the anterior and of the posterior surfaces of the vertebræ and of the intervertebral cartilages, the Webers caused the spine to be bisected in the mesial plane, after the viscera had been removed from the cavities of the thorax and abdomen, the space having been filled up with liquid plaster of Paris. The relative normal positions of the various portions of the spinal column were thus obtained, and from the section the accompanying figure (Fig. 55) was taken, which represents most accurately the forms of the several curves and the proportions of the bones and cartilages which together constitute the spinal column.

But it has been already shown that the physiological—antero-posterior—curves do not exist at birth; and that, when first observed, they are not permanent, but are lost in the horizontal posture. Further, these inequalities in the vertebræ and in the intervertebral substances do not exist at birth, nor are they found until the spinal curves commence to

FIG. 55.



be permanent. Also, they increase with age. Such being the case, it follows as a necessary consequence that these differences in the anterior and in the posterior surfaces of the bodies of the vertebræ, and especially in the fibro-cartilages, are due to the antero-posterior curves—are due, in fact, to the erect position and to the pressure from above downwards consequent on that position.

The effect of pressure on the intervertebral cartilages is shown by the loss of height which is sustained at the end of the day. Thus it is well known that a man of middle stature, who remains in the erect posture during the day, will lose nearly one inch in height, and that this is regained only after he has been in the recumbent position for six or eight hours. We must conclude, therefore, that these varying thicknesses of the bodies of the vertebræ and of the intervertebral substances are produced by pressure as a result of the erect position, and that they would never be developed any more than the antero-posterior curves themselves, in the horizontal position.

Thus, it may be stated that the antero-posterior curves of the spinal column result as a consequence of the erect position and from muscular action in maintaining equilibrium, and that unequal pressure occasions thinning of the bodies of the vertebræ and of the intervertebral substances in the concavities of the curves. This view will be confirmed by the consideration of pathological curves.

CHAPTER XVI

ANTERIOR CURVATURE OF THE SPINE

Anterior curvature of the spine affects, for the most part, the lumbar region of the spine, and is an abnormal increase of the physiological curve of that region. It occurs also, however, in the cervical region in infants. It is then due to rickets and to deficient muscular power, and sometimes also it is due to caries. When anterior curvature takes place in the lumbar region it is, for the most part, of rachitic origin. Sometimes it is hereditary, and then, also, it depends on a rickety condition; and, again, it results, as has been already mentioned, from congenital dislocation of the heads of the thigh-bones. In these cases distortion is sometimes very remarkable. I have seen cases in which this result of dislocation had been treated during three years and more as a primary affection, and without any suspicion being entertained as to the immediate cause of curvature.

Anterior curvature is for the most part limited to the lumbar region of the spine, the dorsal and sacral portions being implicated only in so much that their normal curves become exaggerated. Occasionally, however, a part, or even the whole, of the dorsal curve may be reversed; and then the anterior curve will consist of the lumbar vertebræ together with the dorsal.

In the lumbar region this distortion may vary from a slight increase of the normal curve of this region to a development which is a source of great weakness. The normal condition has already been shown. Through increase of this curve the obliquity of the pelvis is augmented, the anterior wall being carried backwards and the sacrum and coccyx being raised; so that their concavities present more directly downwards, and the superior portion of the pelvis inclines forwards. The sacro-lumbar articulation, in consequence, is no longer found immediately above the interfemoral line, but in advance of that line. Thus the equilibrium of the body is disturbed, and it is necessary that the weight of the upper part of the trunk shall be thrown behind the vertical line of the body. In this manner a compensatory antero-posterior dorsal curve is produced.

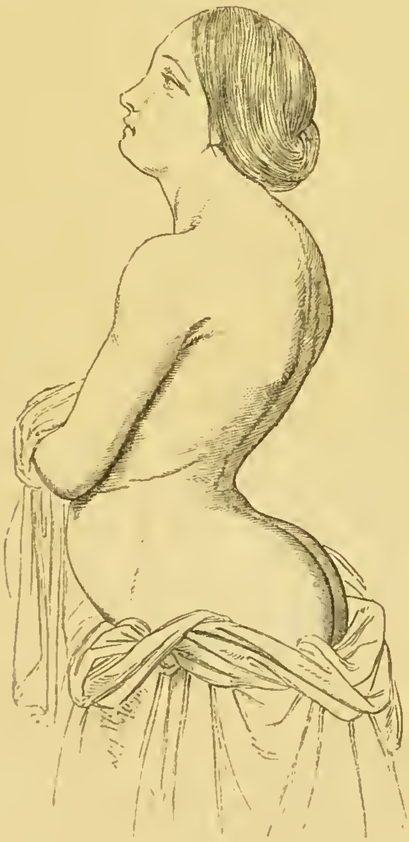
Symptoms.—The external appearances presented by this distortion, then, are such as are indicated by the changes in the skeleton above mentioned. They are well represented in Fig. 56. The lumbar region is rendered remarkably hollow, while the dorsal is rounded; the nates are raised, and the head is thrown back. The abdomen is unusually prominent, and the stature is necessarily stunted. When the distortion occurs in childhood growth is impeded, and when it takes place in the adult much loss of height is incurred.

Causes.—The causes of lordosis are numerous. As a congenital affection it is combined with monstrosity, and with spina bifida. In childhood this deformity is sometimes observed as a result of rickets.

An hereditary disposition to lordosis is also some-

times observed; one or more members of a family being affected. It may be the only sign of a rachitic tendency, or a more severe and general form of rachitic affection may present itself. In some members the cachexia is so marked that the whole

Fig. 56.



skeleton partakes, and no portion of it remains unaffected. When the pelvis is much contracted and anterior spinal curvature is at the same time considerably developed, natural parturition may be prevented, and the Cæsarean section, or other such means, may become necessary for the removal of the

fœtus. Such instances are recorded by Ramsbotham, Kilian, and others. In these cases softening of the bone had allowed excessive distortion to be produced; but it is inaccurate to describe this distortion as dislocation. It is not possible, even in extreme instances of distortion, that dislocation of the lumbar vertebræ shall be produced in these cases. The instances of distortion, which have been thought by some to be dislocations, have been proved to be rachitic distortions, both by the positions of the spinous processes, and by the general conformation of the trunk.

Whatever tends to increase the obliquity of the pelvis will give rise to this form of distortion. Thus, it is a necessary consequence of congenital dislocation of the heads of the thigh-bones (upwards and outwards). In some instances arising from this cause the distortion is very remarkable. A child was lately under my care for congenital dislocation of the thigh-bones, in whom lordosis was very marked; so much so, indeed, was it that the congenital dislocation had been entirely overlooked, and attention had been directed to the spinal curvature alone—a result only of the dislocation.

Lordosis may be induced equally by unreduced non-congenital dislocation of the thigh-bones. Thus, it exists in a very marked degree in a young man, twenty years of age, whom I lately had occasion to see, who has suffered successively in each hip-joint with rheumatic inflammation and subsequent dislocation of the head of the thigh-bone on to the dorsum ilii, and in whom it was impossible, notwithstanding every care, to arrest the disease. In these

cases, as in those last mentioned, great efforts are made to sustain equilibrium; the extensor muscles of the trunk are rendered tense and prominent, and, standing out firmly, they leave, especially towards the lower part of the spine, a deep sulcus in the median line.

I lately saw, together with Mr. Brookes, a similar deformity, but arising from a totally different cause, at Shaldon, in Devonshire; and I allude to the case because it is rare. Fatty degeneration of the muscles of the abdomen had taken place, and the abdominal viscera hung suspended consequently in a huge, tumid paunch; the weight of which had, in part, occasioned the distortion in question. This distortion was one of the most remarkable that I ever witnessed. The effect was increased, also, by fatty degeneration of many other muscles, such as the trapezii, rhomboidei, serrati, latissimus dorsi, the pectoral muscles, and those of the lower extremities. Many of these muscles were so far destroyed that they could not even be traced. In this instance, the unsupported pendulous belly, together with the loss of muscular power, seemed to give rise to lordosis, in a somewhat similar manner to that in which the gravid uterus is sometimes known to act.

Bearing heavy weights round the neck and shoulders will also occasion lordosis. That a considerable burden may thus be slung, borne upon the neck and shoulders and suspended in front, it is necessary that the shoulders shall be thrown back, and that, consequently, the loins shall be projected forwards. If this practice is continued, the increased lumbar curve becomes more or less permanent. I

have also known gymnastic exercises to produce a somewhat similar result.

Pathological Anatomy.—The pathological changes which are induced are chiefly as follows. The lumbar spines are approximated; the articulating processes of the vertebræ are pressed forcibly into contact one with another; the posterior ligaments become somewhat shortened, and the ligamenta subflava lose something of their elasticity; the bodies of the vertebræ undergo absorption and the intervertebral substances are compressed posteriorly; while expansion of these substances takes place on the anterior surface in the convexity of the curve. The extensor muscles of the trunk are strongly developed. Ankylosis of the articular processes of the vertebræ, with or without fusion of the bodies, may at length take place, through which the spine is rendered immovable and the distortion permanent.

Anterior curvature is, for the most part, limited to the lumbar region of the spine; the dorsal and sacral regions being implicated only so far that their normal curves become exaggerated. Occasionally, however, some few of the lower dorsal vertebræ may become involved, together with the lumbar curve; or, indeed, the entire dorsal curve may be reversed, and the anterior curvature will then consist of the lumbar vertebræ together with the dorsal. This is, necessarily, a very rare form of distortion, and it indicates great weakness of the muscles and ligaments of the spine. In an instance which I lately saw the sacrum was almost horizontal, and the head was forcibly thrown back.

Treatment.—It has already been said that lordosis is seldom a primary affection, but that it is the result of disease, or that it arises from the position of parts which are entirely independent of the lumbar region itself. This affection is for the most part developed in childhood. In childhood, however, the normal curves of the spine disappear in the horizontal position. Hence it is obvious that the recumbent posture must be in itself a powerful agent in the treatment of this form of curvature. Doubtless, whatever the cause of anterior curvature may be, the treatment should be followed whilst the child is recumbent. The supine position is the best in which to place the child; for the shoulders can then be raised, whilst, in addition, the thighs may be flexed on the pelvis. In this manner an anterior spinal curve may at length be removed.

When this form of spinal curvature has been induced by rickets, it is especially important to observe the recumbent posture; for the upright position tends to increase the spinal curve, and will probably also occasion some distortion of the lower limbs.

Cases occur, however, in which it is not practicable to observe constantly the recumbent position, and it then becomes necessary to substitute for it a portable instrument, which, receiving the weight of the head and shoulders, transmits it to the pelvis. The spinal column is thus relieved, and the extensor muscles are less violently thrown into action. It is a very imperfect substitute, however, for the recumbent position.

CHAPTER XVII

POSTERIOR CURVATURE OF THE SPINE

Posterior curvature of the spine is a much more common affection than that last mentioned. It occurs both in childhood and in old age; and, indeed, no age is exempt. In infancy, all the dorsal vertebræ are engaged in this curve; while in youth the middle and upper portions of the dorsal spine are especially implicated; but in old age the spine is most bowed in the upper dorsal region. In infancy, the muscular system is mainly affected; while in later life the skeleton becomes altered, and the intervertebral substances are compressed.

Causes.—The causes of posterior curvature of the spine are debility—whether in infancy, in youth, or in old age; rachitis, muscular rheumatism, and partial paralysis. Some occupations are apt to induce a stoop in those engaged in them. Thus it is, for instance, with watchmakers, engravers, embroiderers, writers, shoemakers, and others, whose occupations require a stooping position. This position, which is at first irksome, becomes at length easy, and more or less permanent. Those, also, who are subject to asthma acquire a stoop which becomes diagnostic of the disease.

Debility, especially in infancy, is the cause of posterior curvature. The curve, for the most part, occupies the entire length of the spine, from the occiput to the sacrum; and, occurring in infancy, it is the least severe form of posterior curvature. The normal curves of the spine have not, as has already been explained, yet been formed, for the muscles of the back have not yet the power to support the trunk; and the head in consequence falls forward through muscular debility. This bowed condition of the spine increases, and the dorsal vertebræ become more prominent; for, notwithstanding its weakness, the child is seldom kept lying down. Nutrition is imperfect, and symptoms of rickets perhaps begin to show themselves; such as frequent diarrhœa, perspiration about the head and neck, general wasting, and a blanched condition of the skin. The child is uneasy and fretful. Swelling of the ends of the long bones may now be observed; especially of the carpal extremity of the radius and of the tarsal end of the tibia; and the vertebræ will probably now assume a somewhat more prominent appearance.

Such children are seldom brought up at the mother's breast, or they are not alone nursed, but are fed at the same time with farinaceous food. Some are born rickety; others become so at the breast, when, at the same time, they are fed with farinaceous food; but a child which is healthy at birth will seldom show symptoms of rickets while it has a sufficiency of milk for nutrition (and without admixture of farinaceous food), and while it is kept warm.

When the child has commenced to walk, a different kind of curve is, for the most part, induced. Here the normal antero-posterior curves have been at least in part developed, that the erect position may be maintained, and consequently the curve which is induced is an exaggeration merely of the normal curve of the region. It occupies especially the middle or the middle and the upper portions of the dorsal region, as is shown in Fig. 57.

FIG. 57.

Occasionally, posterior curvature resembles angular curvature of the spine so closely as to be mistaken for it. In the instance from which Fig. 58 was taken a rachitic tendency was hereditary; and consequent on this condition, excessive distortion was induced, such, indeed, as I never saw equalled.

Fig. 58.

In *youth* posterior curvature occurs not unfrequently, during rapid growth, as a consequence of debility. At this period the lower cervical and the upper dorsal vertebræ are especially affected. A stoop which is thus acquired during convalescence

may continue permanently in manhood. Also those who are short-sighted and who do not habitually wear glasses are apt to accommodate their figures to their imperfect vision and thus to acquire a stooping position. Posterior curvature is not attended with tenderness in the course of the spine, so that firm pressure may be made along the spine without causing pain. Should, however, tenderness be found on examining the spine, destructive disease, or caries, must be suspected. And, indeed, caries is often so insidious in its advances, that great and irremediable deformity may already have taken place before the affection is recognised.

In *old age* an abnormal increase of the dorsal curve is common, as a result of muscular debility. And this is also the case when posterior curvature has been induced by any occupation, or through disease, as rheumatism, &c.: it is then not unfrequently greatly increased in old age. Under these circumstances, equilibrium cannot be maintained, and a stick becomes necessary for support.

Pathological Anatomy.—The pathological appearances differ according to the age at which posterior curvature is observed. In infancy the muscular system is chiefly affected; while in the adult the intervertebral substances become compressed anteriorly; and in old age fusion of the bodies of the vertebræ, or more partial ossification, may be found. Together with these changes, the whole trunk is more or less affected; the chin rests on the sternum, the ribs are approximated, and respiration is laboured in consequence of their diminished motion.

Treatment.—In childhood the horizontal position should be observed until the curve is removed. Then, as strength is gained, means may be taken to increase muscular power by well-directed exercises ; and as it becomes developed, so the antero-posterior curves of the spine become formed and the erect position is maintained. In more advanced age mechanical support is necessary to redress the bent spine or to assist nature.

CHAPTER XVIII

LATERAL CURVATURE OF THE SPINE

LATERAL curvature of the spine is that form of distortion in which the vertebræ deviate in a lateral direction from the mesial line of the trunk. This affection may be divided into two stages, or periods; namely, first, *incipient curvature;* and secondly, *confirmed lateral curvature.*

By incipient curvature is understood such a condition of lateral deviation of the spine as is removable in the recumbent position, with the help perhaps of some slight pressure; while a confirmed curve requires the application and long continuance of mechanical means for its removal.

Lateral curvature is the most common form of spinal curvature. It occurs more frequently in the female than in the male sex; it seldom commences after the age of puberty, and it does not commonly occur as a primary affection.

Causes.—The principal predisposing causes of lateral curvature are debility—muscular or constitutional, acquired or inherited—and rickets; and the exciting or proximate causes are bad habits of sitting or of standing,—such as sitting for prolonged periods in a constrained attitude, as is often assumed in drawing or in writing, and, as frequently happens

in schools, when the back is not supported and the muscular strength is insufficient to enable the child to sit upright: the pelvis and trunk are then inclined to one side or the other to obtain temporary relief. But the most common cause of lateral curvature is the habit of standing, more or less, on one leg. This habit is indulged in to a very great extent by young girls, to gain relief either in consequence of some local weakness or from fatigue; for weariness is readily induced during the period of growth, and especially when growth is rapid. This attitude causes the hip to become prominent, and the pelvis to be inclined towards the opposite side. Together with this obliquity of the pelvis, the spine also becomes curved. At first the curve is temporary, and is removed in the recumbent position; but at length, as the obliquity of the pelvis becomes permanent, so the curve also becomes confirmed; and thus the equilibrium of the trunk is disturbed. Equilibrium is restored by means of secondary or compensating curves; and these are formed in a regular series, and are determined by the position of the primary curve.

Debility, then, is the chief predisposing cause of lateral curvature of the spine; and the most frequent exciting cause is obliquity of the pelvis, which is induced by bad habits of sitting or of standing. But, although these are the chief causes of obliquity of the pelvis and lumbar curvature, others exist; for any cause acting mechanically to disturb the equilibrium of the body may induce spinal curvature. Thus inequality in the length of the lower limbs, whether produced by a bent tibia or femur, by flat-

foot or knock-knee, by muscular contraction, articular disease or partial loss of muscular power, will induce obliquity of the pelvis and a primary lumbar curve.

Take, for instance, the case of a child whose health is delicate from whatever cause. If it be treated in the same manner as a stronger companion some irregularity of form will probably develop itself; but the particular form of distortion will depend mainly on the habits of the child. Thus, if the child stand or walk much, the internal lateral ligament of the knee-joint may yield and occasion genu valgum; and this will probably be followed by yielding of the ligaments of the ankle-joint, and of those in the sole of the foot, giving rise to flat-foot. Suppose, again, that through standing habitually on one leg, one knee and foot become more affected than on the other side, that extremity necessarily becomes, by so much as the knee is more bent and the foot is flatter, shorter than the other; and therefore, when both feet rest on the ground, the pelvis becomes oblique through the difference in the length of the extremities. But an oblique pelvis must give rise to spinal curvature.

Fig. 59 was taken from such a case.

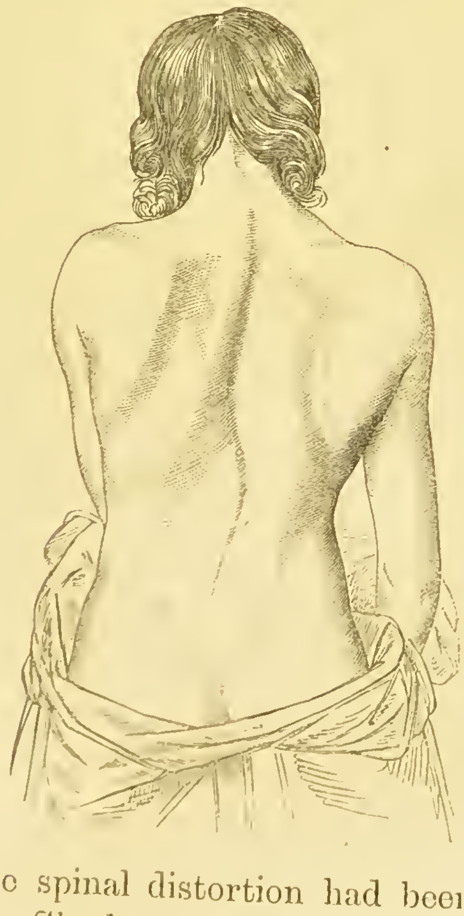
The child was 12 years of age, and she habitually stood on the right leg.

The prominent features of this case may be thus described. There was genu valgum and flat-foot on the right side, and the right side of the pelvis was, in consequence, lower than the left. This occasioned obliquity of the pelvis and a lumbar curve, with its convexity towards the right side; and this was com-

pensated by a dorsal curve in the opposite direction, namely, with its convexity towards the left side. It followed as a consequence of these curves that the right shoulder was three fourths of an inch lower than the left, and that the right side of the pelvis was half an inch lower than the left side.

Again, Fig. 60 was taken from a young person, sixteen years of age, who, from overgrowth, had become

Fig. 59.



feeble. The spinal distortion had been four years in forming. She habitually stood on the right leg.

Both of these distortions, which are here represented in Figs. 59 and 60, were due to debility.

In the first, the internal lateral ligament of the knee-joint having yielded, genu valgum was induced, and the pelvis was inclined towards the same side. Then, as a necessary consequence, spinal curves—a primary lumbar and a consecutive dorsal curve—were formed. While in the second, from constantly

FIG. 60.

standing on one leg, the pelvis became oblique, falling towards the opposite side, as is well shown; and a lumbar curve was necessarily produced with its convexity towards the lowest ilium. This distortion was not in the first instance constant, for

it could be removed when the patient was lying down. It was an incipient curvature which required time and the continuance of a bad habit to make it a permanent curve. But it required a short time only to effect this purpose; for when I again saw this patient after an interval of some few months, there was produced the condition which is represented: the primary curve had become permanent, and had given rise to a secondary or dorsal curve. The existence of the secondary curve is a proof of the permanent character of the primary curve; for while the primary curve is incipient only, or removable in the horizontal posture, the secondary curve does not form; but the compensating curve begins to form so soon as the primary curve becomes in the slightest degree permanent.

Those who are feeble, whether from overgrowth or during convalescence, constantly change their position while standing; so that they rest for a short time only in one position and change it for another—from both feet to one foot, for instance, and back again. And it is found that it is habitually the right foot in some cases, and in others the left foot, which has, in this way, to bear very frequently almost the entire weight of the body, until, at length, it becomes more natural to stand on one leg only, than fairly on both. It becomes so natural to do this, that it is done unconsciously; and until it is pointed out, the patient is frequently not aware of the habit. This occurred and was frequently pointed out, in the case from which Fig. 60 was taken.

But debility alone does not usually give rise to lateral curvature of the spine: bad habits of stand-

ing or of sitting are superadded, which occasion obliquity of the pelvis and a primary lumbar curve. These habits depend, however, on debility, and therefore it is right to speak of debility as the cause of these deformities. But lateral curvature of the spine may be occasioned by general debility, without obliquity of the pelvis having taken place. It may commence as a dorsal curve, as in the instance from which the following figure (Fig. 61) was taken. This is a form of curvature which commonly begins during convalescence; and commencing as a dorsal curve it does not depend primarily on obliquity of the pelvis, nor on any affection of the lower extremities.

Every distortion is produced by a special cause; and it need scarcely be said that while the cause of curvature remains, the curve itself cannot be removed, or if removed it will certainly recur, inasmuch as the cause which first occasioned it still exists. It is of the utmost importance, therefore, in the treatment of spinal curvatures to ascertain precisely what has been the exciting cause of deformity. But this primary investigation is unfortunately greatly neglected, and its importance is not generally understood; so that with many the treatment of spinal curvature is simply to apply a spinal instrument, without reference to the cause of curvature. This was well explained by Mr Cæsar Hawkins in his lectures given at St. George's Hospital.*

It is well known that the muscles of the back of those who have worn tight stays are not red and firm, but that they are, for the most part, pale and

* 'London Medical Gazette,' vol. xxxviii, p. 311, 1846.

weak. Few will doubt that the muscular debility which is thus induced tends to the formation of curvatures of the spine. It will, perhaps, be said,

Fig. 61.

however, that debility of the muscles of the trunk being induced equally on both sides, there is no reason why lateral curvature of the spine should follow. It should be remembered, however, that the causes which act on the spine to induce curvature operate with increased force when the power of the muscles of the back is diminished. Debility is in numerous instances the immediate cause of lateral curvature.

Again, another series of causes exists which induce spinal curvature—namely, such as alter inordinately the relative power of the upper limbs. Thus the power may be increased or diminished—increased by extraordinary use, as through carrying a burden

Fig. 62.

on one arm, or as occurs in certain trades, where one arm is much more employed than the other. This is shown in Fig. 62, which was taken from a young person who habitually carried a heavy child on the left arm. And thus it is found that nurses, needlewomen, tailors, shoemakers, compositors, and

some others are unusually liable to affections of this kind. Also, when muscular power is diminished, as through paralysis, partial or complete, of an upper extremity, or after amputation at the shoulder-joint or immediately below the joint, lateral distortion of

Fig. 63.

the spine occurs in the dorsal region, the convexity of the curve forming towards the opposite side. It is well shown in the accompanying figure how amputation by destroying the action of the muscles of the left shoulder has occasioned those of the opposite side to draw the spinal column away from the median

line, curving it towards the right side. Some of the causes above enumerated are in themselves sufficient to induce spinal curvature ; but this is produced both more rapidly and more certainly when there is a condition of general debility present, whether such as is found during convalescence or through overgrowth, or such as is induced by overwork and insufficient food.

Rickets is another cause of lateral curvature of the spine. This, however, is a general disease which involves not the bones only, but every tissue of the frame. It is sometimes hereditary ; but much more frequently it is developed after birth, through exposure to cold and through insufficient or improper food. Diarrhœa is established, and it is followed by wasting and pallor, and subsequently by swellings of the ends of the long bones. The whole skeleton may become more or less softened, and then the bones become curved through mechanical causes. Especially the lower limbs become curved, whereby the pelvis is rendered oblique, and spinal curvature is induced. In this form of disease, not only is spinal curvature induced at an earlier age than when it arises from debility, but it is of an infinitely more severe form. In the case from which Fig. 64 was taken, rickets was first developed at eight years of age, and the child was thirteen years old when the drawing was made. The lower limbs first became bent ; then the pelvis was tilted to one side and was flattened, and the spine became curved. Distortion is never so great in childhood from any other cause as when it is induced by this form of disease.

This rickety condition of the spine is sometimes, though rarely, developed without the long bones being affected. There will then probably be seen also rickety deformity of the ribs and of the sternum.

Fig. 64.

Also, there is a form of curvature which is transmitted with a strumous diathesis, and which pervades certain families. There are families, of which every member is thus afflicted—some severely, and

others slightly; but all, or nearly all, are affected with spinal curvature. In these cases there is present both constitutional and muscular debility.

There are still two other very rare varieties of lateral curvature to which it is only necessary to allude—viz., curvatures arising from malformations of the vertebræ, and those consequent on disease within the thorax. In the former there is occasionally seen, either a deficient development, or an excess of development in the lateral halves of some of the bodies, and indeed of other portions of the vertebræ. There is a remarkable example of this malformation in the museum at Vienna, which I lately examined, aud which consists of four half-vertebræ, with their half-arches and proccsses in excess.* These occasioned curvature of the sacrum, slight curvature in the lumbar and the lower dorsal regions, considerable curvature in the middle dorsal region, and also a considerable curve in the upper dorsal region. Again, I have lately seen a somewhat similar instance of deformity in a child of thrce months old. In this instance, however, the greatest deformity was found in the lumbar region.

Effusion into the cavity of the thorax, and which is followed by collapse of one side, is subsequently compensatcd by enlargement of the oppositc sidc. After the effuscd fluid has been removed from the pleural cavity, the ribs sink to the compressed lung, the lung itsclf being bound down by adventitious membranes, so that it cannot expand. Thus, the side bccomes flattened and the lung remains con-

* Vide Rokitansky's 'Pathological Anatomy,' Sydenham Society's edition, vol. iii, p. 228.

tracted. Compensation afterwards follows, through amplification of the sound lung and enlargement of its containing cavity. When it arises from this cause the curve occupies the entire dorsal region. Its appearance is shown in Fig. 65.

Fig. 65.

MODES OF FORMATION OF SPINAL CURVES.

From what has already been said, it will be understood that when a cause acts mechanically from below and produces obliquity of the pelvis, it must in the first instance give rise to a lumbar curve, just as

wry-neck will first occasion a cervical curve. And as the causes which act from below upon the spine are both more varied and more frequently met with than those which affect the upper extremities or the neck, so it is found that spinal curvature commences much more frequently in the lumbar than in the dorsal or the cervical regions.

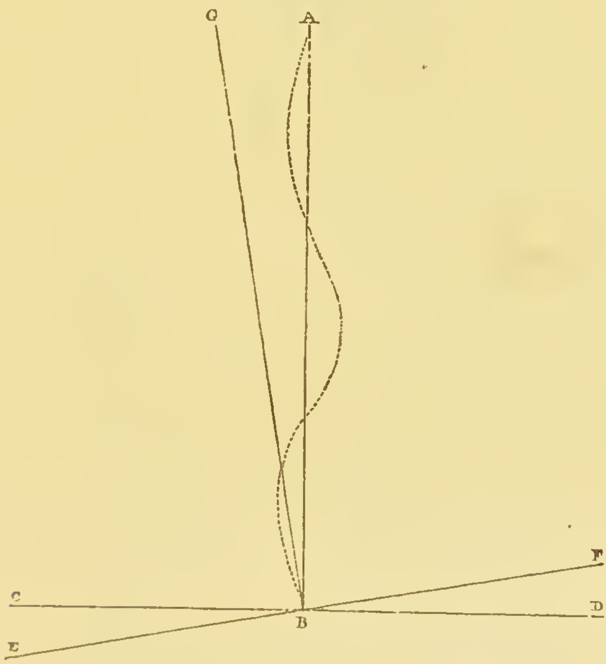
In the upper classes, amongst whom lateral curvature is common, it is the rule that the lumbar curve is first formed ; while in the labouring classes, who use their hands and arms much, in carrying burdens and in other manual labour, the dorsal curve is very frequently first developed. A spinal curve cannot, however, remain single except in the horizontal posture ; but, that the equilibrium of the body may be restored, a second or compensating curve must be formed, otherwise the erect position cannot be maintained. But a primary curve is never entirely compensated by a secondary curve, and therefore other curves form above and below it. Thus a dorsal curve is always followed by others —one above as well as one below it ; and a severe lumbar curve not only occasions a dorsal but also a sacral curve. One curve runs into the other, so that as one forms another is forming.

Thus a primary curve may be lumbar, dorsal or cervical, and the position of the primary curve is determined by the exciting cause of distortion; while compensation takes place through the formation of secondary curves, which are produced by the muscular effort to maintain the erect position. These curves are always undergoing change and becoming more rigid and compressed, until at length

the height of the trunk may be considerably diminished.

Perhaps the modes in which spinal curves are formed will be more readily understood by means of the following diagrams (Figs. 66 and 67).

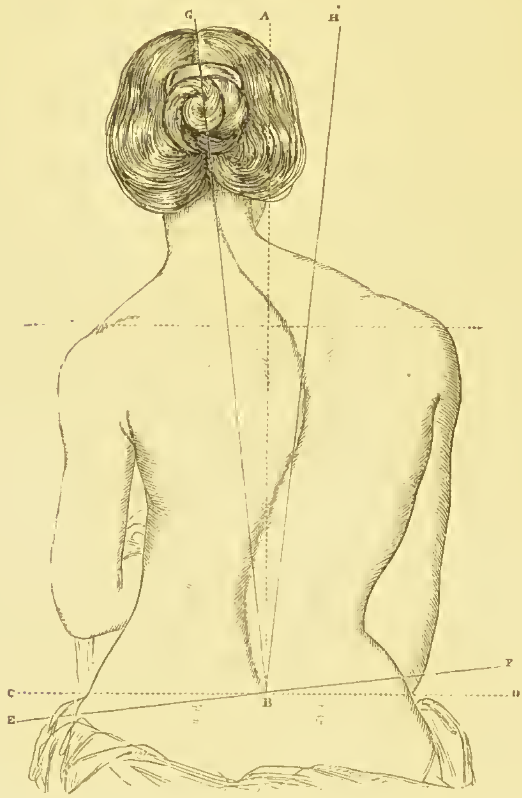
FIG. 66.



Suppose the lines A, B, C, D to represent the pelvis and the spinal column in their normal relations; namely, the spinal column forming a right angle together with the pelvis; and let E F represent the pelvis rendered oblique, from whatever cause; and G B the inclined column still forming a right angle with its base. How is equilibrium to be maintained? It is obvious that the line G B, if continued, would render equilibrium impossible; and, therefore, a series of curves about the perpendicular

line A B are formed to maintain equilibrium, as is better shown in the following figure.

Fig. 67.



It will be seen, however, in Fig. 67, that the cervical curve corresponds to the line G B. And such must, indeed, more or less, be the case until equilibrium is restored through increase of the spinal curves: then the cervical curve approaches the perpendicular line, as is shown in Figs. 66 and 68.

The symptoms and external characters of this affection vary according to the region in which the primary curve is formed, and also they vary as the compensating curves vary.

When, from any affection of the lower limbs, the pelvis has become oblique, the spine must become curved in the lumbar region; and from the concurrence of these two conditions—namely, the depression of the ilium on the side of the lumbar convexity, and the loin falling in through the recession of the lumbar

Fig. 68.

vertebræ in the formation of the lumbar curve—the hip becomes prominent. This appearance is constant, and it is one of the most striking symptoms which is observed: it may always be seen even before a secondary dorsal curve is fully formed.

Again, when spinal curvature commences in the

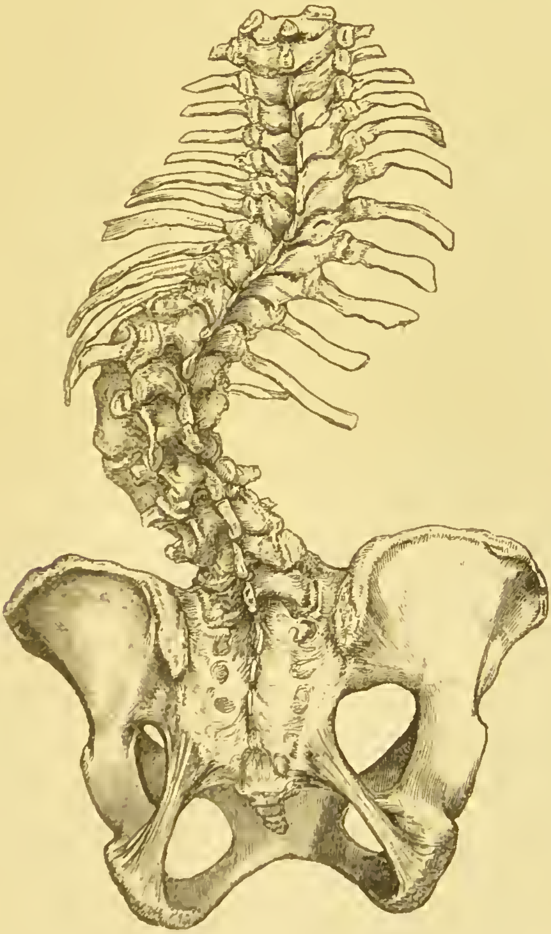
dorsal region, or when a compensatory curve has been formed in this region, the shoulders are not placed on the same level—one is raised while the other is depressed, and the scapula becomes unduly prominent on the convexity of the dorsal curve: the shoulder is popularly said to be "growing out." This increased prominence of the shoulder is due, in part, to the increased angularity of the ribs, and in part also to muscular action. In the formation of the lateral curve the vertebræ become somewhat twisted or rotated, and consequently the angles of the ribs on the convexity of the curve project abnormally, while the ribs themselves are rendered more horizontal in their direction and are more widely separated from each other than in their normal condition; but on the side of the concavity the ribs become oblique and are depressed, so as to lie one upon another, or even they overlap one another. The flattening of the front of the chest also is remarkable. On the side corresponding to the concavity of the spinal curve the ribs become, however, unduly prominent at the lower part of the thorax, and thus the greatest diameter of the chest, in an advanced case of dorsal curvature, is in an oblique direction from behind forwards.

Pathological Anatomy.—The pathological conditions which result from lateral curvature of the spine may be divided into those effects which are produced immediately upon the spine and trunk, and those which are consequent upon these changes.

Confirmed lateral curvature is not purely a lateral deviation, except when it takes place from pulmo-

nary or pleural disease. In these cases the absence of rotation is remarkable. So soon as curvature becomes permanent, and this change takes place very rapidly after the curve begins to form, the vertebræ which are involved in the curve be-

Fig. 69.



come rotated on their axes in such a manner that the anterior surfaces of the bodies of the vertebræ occupy the convexities of the curves, and consequently present more or less laterally. In

a severe case, such as that from which Fig. 69 was taken, the anterior surfaces of the bodies of the vertebræ have undergone such an amount of rota-

Fig. 70.

Fig. 71.

tion that they have acquired a lateral instead of their normal direction, and occupy the greatest convexities of the curves. But although the bodies of

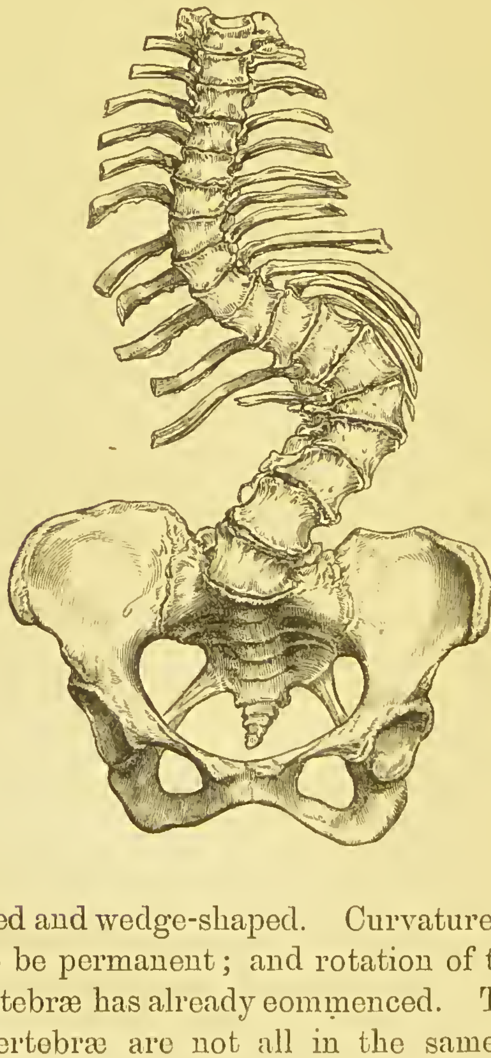
the vertebræ may have become thus rotated, the spinous processes may perhaps undergo only slight change, so as scarcely to indicate a lateral curve. These points are well shown in Figs. 70 and 71, especially in the dorsal region. If treated by a novice, this would scarcely be recognised as a spinal curve, although the bodies of the vertebræ are rotated to the extent of nearly a quarter of a circle.

Perhaps the course of the spinous processes in the lumbar portion of the spine is even more remarkable than in the dorsal region, considering the greater rotation which has taken place—rotation equal to one fourth of a circle. Thus it is that a spiral twist of the spinal column may exist to a very great extent, through rotation of the bodies of the vertebræ, without the apices of the spinous processes describing a corresponding curve. Many become hopelessly deformed, because it is not rightly understood how spinal curves are formed; and also because measures are not taken in the commencement of the deformity to remove the curve.

While a lateral deviation of the spine is incipient only, the intervertebral cartilages become compressed laterally, and they recover their form when the superincumbent pressure is removed; just as is well known to occur in health, when a man of ordinary stature, who has been in an upright position during the whole day, loses three fourths of an inch in height, through the compression which takes place of the intervertebral substances, and which he regains only after some hours spent in a recumbent posture.

When, however, these intervertebral substances become unequally compressed, and this effect is continued from day to day, they lose in a measure their elasticity, and do not recover their full form during the period of repose, but remain somewhat

Fig. 72.



compressed and wedge-shaped. Curvature may then be said to be permanent; and rotation of the bodies of the vertebræ has already commenced. The bodies of the vertebræ are not all in the same measure

rotated; but those are most rotated which are nearest to the centre of the curve, and that vertebra which is central is the most rotated and the most wedge-shaped. This is shown in Fig. 72, where the vertebra in the centre of the lumbar curve is represented as wedge-shaped and rotated to the extent of one fourth of a circle, while those above and below are both less rotated and less wedge-shaped. And in the same manner the intervertebral substances which enter into the curve are reduced in thickness.

In contrast with these are Figs. 73 and 74, from an articulated spine, where the anterior and the posterior surfaces agree perfectly, and where the vertebræ are piled one above another with great care after the fancy of the constructor, but unfortunately without the slightest regard for truth. Such is the manner in which articulated spines are invariably put together; and this mode of articulating curved spines tends to perpetuate an error. It is only fair to say, however, that the vertebræ having been taken asunder and the intervertebral cartilages removed, it is no ordinary puzzle to put the several parts together again as they had grown.

In the figures above (69, 70, 71, 72) it will be seen how the bodies of the vertebræ are rotated towards the convexity of the curve, and how in the concavity the bodies, through pressure, become wedge-shaped. That vertebra which is the most central is also the most compressed: it may lose more than half of its thickness. It will further be seen that the spinous processes are somewhat curved towards the concavities of the curves, but not in the

same degree as the bodies of the vertebræ are rotated into the convexities. They may even scarcely be removed from the middle line of the trunk, notwithstanding that the bodies themselves are immensely rotated and occupy the convexities of the curves.

Fig. 73.

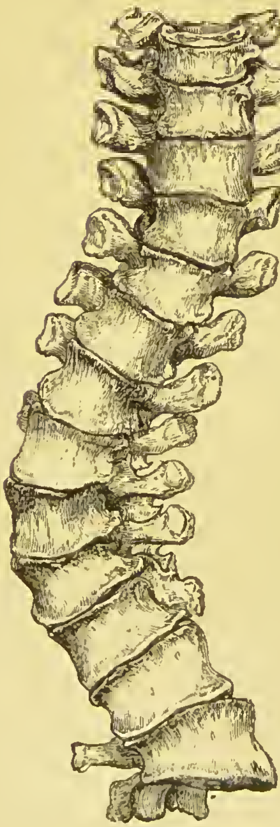


Fig. 74.

Through pressure, the cancellous structure of the vertebræ becomes somewhat consolidated, and the outer surface of the bone is thickened and rendered more dense.

It is true that this spiral twist of the spinal column has been alluded to by several authors, but it is not understood that spinal curvature can exist without the apices of the spinous processes also describing a curve, similar to that formed by the bodies of the vertebræ. Thus, many become hopelessly deformed through inattention to commencing distortion, and through want of knowledge with regard to the manner in which rotation of the bodies of the vertebræ takes place.

This rotation, which is the immediate result of lateral curvature, occasions unequal pressure, and produces partial absorption of the intervertebral cartilages, as well as of the bodies of the vertebræ.

Thus it is clear that, in defining a spinal curve, we should not be too rigidly guided in our judgment by the line of the spinous processes; but that the condition of the entire trunk should be considered. The line of the spinous processes is often such that, if it alone were considered, the diagnosis as well as the prognosis of the affection must be incorrect.

The *transverse processes* of the lumbar vertebræ on the side of the convexity of the curve are rendered prominent, causing the erector spinæ to project; while, on the opposite side, these processes can be only imperfectly felt. And through rotation of the vertebræ, the articulating processes become partially absorbed by undue pressure, and their articular facets are lengthened.

These changes in form of the vertebræ during the development of lateral curvature are very remarkable; but perhaps the most striking change is that which is effected in the shape of the thorax. The

ribs necessarily follow the altered positions of the vertebræ to which they are attached, and undergo a movement of rotation backwards on the convex side of the curve, so that their angles are rendered more prominent, and they become more horizontal in their direction, while the intercostal spaces become wider than in their normal state ; but on the concave side the ribs sink and become flattened, the intercostal spaces also become more or less effaced through overlapping of the ribs, and the ribs themselves are carried forward and become prominent on the anterior and lower part of the chest. On both sides of the chest the ribs are flattened. Also on the convex side of the curve, in consequence of the rotation of the bodies of the vertebræ into the convexity and the flattening of the ribs, the lung is compressed. Through these changes in the form of the thorax and others which are coincident with them, the capacity of the chest is diminished. Further, the appearance of distortion is much increased by the prominence of the scapula. On the convex side of the curve this bone is thrust up, and is placed obliquely, through the increased angularity of the ribs ; and it is still further raised by muscular action.

In an ordinary case of lateral curvature of the spine the pelvis is rendered oblique. The ilium on the side of the lumbar concavity is raised and carried backward, and on the opposite side it is depressed and carried forward. When the superincumbent weight is unequally transmitted to the ground, the pelvis becomes slightly flattened. And when affected with rickets, the pelvis becomes flattened from above downwards, both through the superincumbent weight

and by the resistance of the lower limbs; so that the space between the promontory of the sacrum and the symphysis of the pubes is diminished. A case of this description is on record, where it was necessary to perform the Cæsarean section, for the pelvis was so much deformed that a ball of one inch in diameter would not pass through the brim.

In the second place I will proceed to examine, cursorily, the result of these changes on the thoracic viscera, as well as those which take place in the structures which are attached to the trunk itself.

The thoracic space, on the convex side of the curve, is diminished by the flattening of the ribs, and by the rotation of the bodies of the vertebræ; and the heart is consequently somewhat displaced towards the concave side of the curve. Respiration is considerably affected; and through imperfect expansion of the chest and lungs, the right side of the heart becomes dilated, and the blood is insufficiently aërated.

The aorta follows the inflections of the vertebræ, being bound down to the spine by its branches; and thus it follows the curves of the spine. Its course under these circumstances, is well shown in a preparation numbered 3416 in the museum of the Royal College of Surgeons. In a practical point of view, this course of the aorta may appear to be a matter of only small importance. It deserves to be remembered, however; for in a thin person, with the convexity of the lumbar curve towards the right side, the aorta may be felt immediately beneath the finger, lying out of its normal course, and on the right side of the umbilicus. I have known ideas of aneurism

to be suggested by the pulsation of the artery under these circumstances.

Together with severe lumbar curvature, there is always found obliquity of the pelvis. This is not a simple tilting to one side (one side being raised while the other is depressed), but there is at the same time a slight movement of rotation of the pelvis itself—which, indeed, is necessitated by the circumstance of the lumbar curve and the rotation of the lumbar vertebræ; so that the anterior superior spinous process of the ilium is not only raised above that of the opposite side, but it is also thrown back; while on the opposite side it is depressed and carried forward. In the female this obliquity is of less importance than in the male. In the male, however, the triangular ligament of the urethra, together with the rest of the pelvis, is twisted, and consequently the direct course of the urethra behind the ligament no longer corresponds with that in front of it. This twisted condition of the urethra may cause a serious impediment to the introduction of a catheter into the bladder, even where stricture does not exist. Should stricture of the urethra be superadded in such a case it would be of considerable importance to remember the rotated condition of the pelvis. I have known more than one instance where, without the knowledge of this fact, it would have been very difficult to introduce a catheter into the bladder. Whenever in cases of severe lumbar curvature it is necessary to use an elastic catheter, this is always withdrawn moulded into a sigmoid curve, similar to the urethral curve.

Treatment.—The treatment of lateral curvature of

the spine can only be undertaken with advantage when the cause of the curvature is known, and also when the order in which the various curves of the spinal column have been formed is fully understood.

It must be obvious to all who reflect on the subject that it is useless to endeavour to remove a spinal curve whilst the cause of curvature yet remains; for, even should the curve be removed, it will recur so soon as the means which were adopted to remove it are discontinued; and the same cause will again affect and distort the spinal column as before. Thus, for instance, suppose some affection of the lower limbs to have occasioned obliquity of the pelvis, a primary lumbar curve and a compensating dorsal curve. The treatment which was formerly adopted was, without reference to the cause of curvature, to make pressure on the convexity of the dorsal curve. This mode of treatment was not only useless, but it was positively injurious: it increased the lumbar curve, and flattened still more the flattened ribs.

The treatment to be adopted is, first, to remove the cause of the obliquity of the pelvis, whatever that may be; and whether it be some affection of the foot, knee, or hip, to treat and remove it, if not before, at least at the same time that the lumbar curve is being treated.

The treatment of spinal curvature should be undertaken so soon as the slightest distortion is perceived. It is difficult to remove a spinal curve at any time; and it is especially difficult to effect this when the disposition to curvature is inherited. Spinal curvature can then only be removed when

mechanical means are well and properly directed to this end. It was with good reason that Sir Benjamin Brodie said, "The treatment of the disease cannot be begun too soon after the first signs of spinal curvature are perceptible."*

A slight curvature of the spine is by some considered to be a matter of such trivial importance that it is unworthy of attention. It is a very serious error to offer such advice, however; and, if followed, must in later years cause much distress. However trivial spinal curvature may appear to be in the commencement, its course is necessarily to increase and to produce deformity, with more or less pain and impairment of the general health. So little are the laws of equilibrium understood, however, that it is imagined by some that a wry-neck, or a "growing-out" shoulder, or an oblique pelvis, is an affair of small importance, and that distortion will probably not increase beyond that which is at the time observed. Some even are bold enough to imagine that a child may "grow out" of these distortions. These are delusions, which observation quickly dispels. It is frequently suggested by those who are but little accustomed to see cases of this description that such deformity is scarcely sufficient to warrant interference, and that it might be well to wait until it had increased somewhat, little doubting that such a curve might be removed at any time. It is now some years since a friend, a most accomplished surgeon, and surgeon to one of our largest hospitals, came with his cousin to me that as he said I might cure her. The deformity was even greater than that

* Lectures on 'Distortion of the Spine not connected with Caries.'

portrayed in Fig. 68; but he expected that she could be cured. He had watched her for eleven years and had done nothing; thinking that the time had scarcely yet arrived for instrumental interference. She was incurable. When curvature of the spine, from whatever cause, has commenced, it must go on increasing until, by the formation of compensating curves, equilibrium is restored.

Having explained how pathological spinal curves are formed, and how they are compensated, so that the equilibrium of the body may be restored, I will proceed to consider the application of mechanical means to the removal of spinal curves.

So long as a spinal curve is incipient, it may not be necessary to have recourse to mechanical support to the spine itself; but it may be sufficient to remove the exciting cause of distortion, and to develop the muscular system by means of well-directed exercises. When, however, these measures are found insufficient, support should be applied to the spine itself without more delay.

If it be a fact that one curve is first formed, and that others are subsequently formed as compensatory of this primary curve—and no one can doubt it who has watched these cases attentively—then it should follow that treatment must in the first instance be directed especially to the removal of the primary curve; for to endeavour to remove a secondary curve without giving efficient support to the primary curve is the most certain mode that could be devised of increasing the original curve. Having determined, then, which is the primary curve, pressure should be made (not on the greatest convexity of the dorsal

curve, to flatten still more the ribs and render the sternum prominent) in that direction which shall tend to restore the positions of the ribs, and which shall also restore those vertebræ which have undergone some rotation to their normal positions. This is most effectively done by applying the force to be used to the lower arc of each curve, whether the primary or the secondary curve, in those instances where the curves are formed from below upwards; but when curvature takes place from above downwards the lower arc of the dorsal curve and the upper arc of the lumbar curve should be supported. When the combined forces of a well-adapted instrument are made to act in the directions now indicated—namely, obliquely towards the centre, they tend to unbend the primary curve. The movement which is thus commenced in the primary curve is often greatly assisted by muscular action on the compensating curve; and in this manner the several curves are at the same time or in succession acted on and unfolded.

This pressure should, as much as possible, be made to follow the course of deviation of the parts themselves; and, consequently, it should never be directly lateral. By using extension in the manner indicated, curves, which otherwise cannot be treated, may be unfolded. This unfolding process is slow. And this will scarcely excite surprise, when the pathological changes which have taken place are remembered: rapid effects are impossible, and should not be expected.

But the time which is necessary for the completion of this unfolding process depends on the degree of fixity of the curve and on the ability to bear the

treatment. Some patients never shrink from the support which is afforded by a well-fitting instrument, while others cannot bear effective pressure. Among the latter are those who suffer from rickets. Again, some cases are necessarily incurable, and they should be recognised as being in this category from the beginning. Such are those which are produced by inflammation and its results within the thorax, and also those which arise from congenital malformation, and again those where ankylosis has taken place, whether in angular or in lateral curvature ; for in the former a slight lateral curve not unfrequently forms above and below an irregular union, and in the latter, bands or bosses of bony matter are sometimes thrown out, which unite two or more vertebræ.

Spinal instruments may be portable, or they may be fixed to a couch. When they are to be worn as portable instruments, they should be made as light as possible consistently with strength and utility.

When the general principle of construction is understood, the apparatus may be variously modified so as to act with the greatest advantage on the distortion, whatever this may be. The pelvic band and lateral supports to receive the weight of the head and shoulders are always necessary ; to which may be added two levers, which may carry a shoulder-sling to act on a cervical curve, and a plate for the dorsal curve ; or it may be required to act on the dorsal and the lumbar curves at the same time, or even to increase the force of the dorsal plate by acting with a separate plate on the pelvis itself. The levers or the plates themselves, may be provided with single

or compound movements. By these means not only can the apparatus be adjusted very perfectly, and be made to fit with great nicety, but the power to overcome distortion is at the same time increased.

Further, by means of adjustments the positions of the plates may be altered as the spinal curves are opened; and since the curves of the plates correspond in some measure to the curves of the ribs, and their obliquity is similar to that of the thorax itself, adjustment does not cause pressure directly in a lateral direction, but it occasions upward or downward pressure according to the nature and the position of the curve to be acted on.

When the instrument fits well, frequent changes are unnecessary; and unless it fits well it is useless. Great pressure is never required, and it may even be hurtful. Modifications, however, are necessary from time to time, to keep up the action of the instrument, and to vary the pressure as the curves are unfolded.

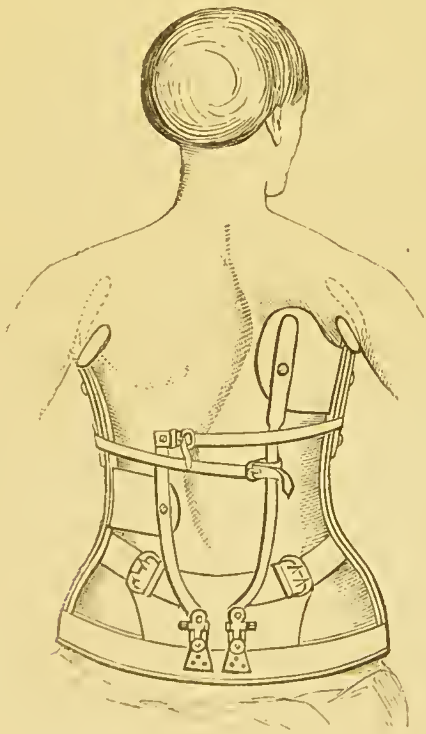
The form of spinal instrument which is usually required is shown in Fig. 75; but the form of instrument necessarily varies as the deformity to be treated is more or less complicated.

In the treatment of these affections the patient should recline in a spinal chair frequently during the day; and the spinal support will then be worn both with comfort and advantage during the whole day. But, although it is important that the spine should be well and efficiently supported, it is unnecessary that an apparatus should be worn at night. The restraint of an apparatus at night is injurious

to health, and the instrument can seldom be worn so effectively that the body during sleep shall not be twisted in it.

But, without doubt, the most effectual mode of treating spinal curvature is on the spinal couch. In the recumbent posture the weight of the body is entirely removed from the spine; and the means to be employed, therefore, are necessarily much more

Fig. 75.



efficient to remove distortion than when portable instruments alone are used. Not only is the recumbent position most favorable for the action of the instrument, but the instrument itself, when attached to the couch, is infinitely more powerful to remove spinal curvature than any portable instrument can

possibly be. The principle on which these instruments are constructed is the same; but the couch, acting with powerful machinery, instead of through a slight cog-and-pinion movement, is so powerful to effect the purpose in view, that it will remove distortion in cases where the portable instrument is useless. In cases of severe distortion, I always recommend the combined use of the couch and the portable instrument, the employment of one alternating with that of the other.

When spinal curvature has been produced by a local cause, or by an acquired habit, the cause must be removed, and the habit must be overcome; without which it is impossible to treat the distortion effectively.

After curvature has been removed, attention should be directed to the development of power by means of exercises which may bring into action the muscles of the trunk and extremities; such as swinging, dancing, riding, swimming, and the like. These exercises, alternating with rest, will, if judiciously employed, rapidly produce a marked increase of muscular power, as well as improvement in the general health. Friction also, such as shampooing, is useful, not only to gain a better condition of the skin, but it conduces to that suppleness of body which, after the removal of spinal curvature, it is important to acquire.

It is scarcely necessary to state that it is of the utmost importance to attend to the general health in the class of cases now under consideration; for constitutional treatment is especially needed where there is debility, and debility is the principal

predisposing cause of spinal curvature. At the same time, therefore, that mechanical treatment is undertaken in order to remove deformity, constitutional treatment should, so far as is possible, be made conducive to the restoration of health.

CHAPTER XIX

WRY-NECK

Torticollis, or wry-neck, occurs both as a congenital and as a non-congenital affection. It is only rarely met with at birth, but it is seen not unfrequently in children from two to twelve years of age; and, indeed, it may arise at any period until middle life.

Wry-neck is occasioned by shortening of the cervical muscles, especially the sterno-mastoid muscle; through which the head is drawn to one side, the ear being approximated to the shoulder and the chin projected in the opposite direction. Not only is the sterno-mastoid muscle contracted, but the trapezius and the scaleni become in a similar manner subsequently affected; and thus the shoulder is raised towards the head, while the head is drawn down towards the shoulder. In this manner a cervical curve is produced, which presents its concavity towards the retracted muscles, and which is followed by a dorsal curve—as has been already explained, when wry-neck was spoken of as a cause of spinal curvature.

One or both insertions of the sterno-mastoid muscle may be retracted; and this is especially the case in congenital wry-neck. On the other hand,

the whole muscle may be retracted, as occurs, for the most part, when the deformity is non-congenital.

Wry-neck produces singular changes in the features. The angle of the mouth is depressed, and the cleft of the eyelids is drawn on to a lower level than on the opposite side; the eyebrow, too, is drawn down, and the side of the face appears to be smaller and less developed than on the opposite side—it is motionless and without expression, while the features on the other side of the face appear to be unnaturally expanded.

When wry-neck is allowed to proceed unchecked, and without any attempt being made to prevent further retraction, deformity results both of the neck and of the spinal column, which may attain to serious proportions.

Treatment.—It is with wry-neck as with some other cases of deformity, that, when discovered and treated at an early period, mechanical means may be sufficient to overcome such distortion as is occasioned by slight muscular retraction. It is, however, rare that extension can be so effectively and continuously employed as to overcome and remove even slight deformity which depends on muscular retraction. And it is preferable to proceed to the subcutaneous section of the tendons of the retracted muscles rather than to lose time in futile attempts at extension.

As in the case of F. S—, in Princess's ward, from whom Fig. 76 was taken, it is sometimes alone necessary to divide the clavicular insertion of the muscle; while, again, as in another instance in the same ward,

the sternal attachment of the sterno-mastoid muscle alone required division. For the most part, however, both the sternal and the clavicular insertions of the muscle should be divided.

When it is required to divide both the sternal and the clavicular portions of the muscle, separate punctures may be made for each portion of the tendon, and the punctures may be made most conveniently about one inch above the clavicle. The knife being carried well behind each portion of the tendon in succession, the tendon will be divided on turning the edge of the knife towards it, at the same time that the head is so held as to make the muscle tense. It is seldom necessary to divide other structures than the two portions of the muscle now indicated, except it be, perhaps, a band or two of fascia; for other contracted structures will probably yield to mechanical extension after the greater obstruction caused by the retracted sterno-mastoid muscle has thus been removed.

After the operation, the head is to be supported in such a manner that the chin inclines towards the breast; so that the little wounds may readily heal, and reunion of the divided tendon may take place. Then, on the fourth or the fifth day, extension, with a suitable instrument, may commence, and be carried on gradually, until the head is raised into its normal position; and, indeed, extension should proceed so far that power may be obtained to move the chin equally to one side or the other.

So soon as the position of the head is restored, care should be taken to remove the spinal curves, and so far as is possible the weakness of the opposed

muscles; for in all cases of this description, and especially in non-congenital cases, there is more or less weakness or even paralysis on the opposite side. The child to whom allusion has already been made, and who is represented in Fig. 76, was only fourteen

Fig. 76.

months old at the time of the operation; but even at that time there was already a dorsal curve of so severe a character that it took much longer time to remove it than was required for the removal of the primary affection—wry-neck—for which she was admitted into the hospital.

CHAPTER XX

ANGULAR CURVATURE OF THE SPINE

Caries of the spine very frequently occurs as a result of inflammation, whether of a strumous or of a rheumatic character. Disease of the spine is, however, essentially of a scrofulous nature. Any portion of the spinal column may be affected by this formidable disease; but the dorsal and the cervical portions are in children more frequently involved than the lumbar portion. In more advanced life disease is not unfrequently of a mixed character—rheumatism in a strumous diathesis; and inflammation then is sometimes found to extend from the sacro-iliac articulation, and to affect the lumbar vertebræ.

Caries of the spine may commence at any period of life, for no age is exempt, and any portion of the spinal column may become diseased; but it is essentially a disease of childhood. The dorsal region is more frequently the seat of caries and angular curvature than either the cervical or the lumbar region, this being not only the most extended portion of the spine, but also the most exposed to injury. In its incipient stage disease of the spine is not unfrequently overlooked, whether in the child or in the adult. Sometimes it is styled neuralgia, or, again,

pain is supposed to arise from pulmonary disease. And it is not alone in its incipient stage that disease is overlooked, for it is not uncommon to see cases of this description where disease has already progressed so far as to have resulted in considerable deformity before caries of the spine is even suspected.

In this form of disease the anterior portion of the spinal column—namely, the bodies of the vertebræ, with the intervertebral substances and the intervertebral ligaments—is alone liable to become carious. The posterior segment, consisting of the spinous, transverse, and oblique processes, with the pedicles and arches, shows but little disposition to pass into a similar state of disease.

An instance in which disease of the posterior segment of certain vertebræ occurred has been placed on record by Dr Buckminster Brown, of Boston, U.S. I give the result of the *post-mortem* examination.

"Body excessively emaciated. There was no curve nor projection of any part of the spinal column. On the anterior face of the bodies of the cervical vertebræ the cyst of an old abscess was found. This cyst contained no fluid, was about the size of a hen's egg, and through an opening formed by the removal of the body of the second vertebræ, and which extended from the first to the third, it communicated with the rachidian canal between the dura mater and the arachnoid. It is probable that the collection of pus existed at first external to the membranes, and finally opened through the dura mater into its cavity, which accounts for the disappearance of the

effused fluid. On opening into the upper part of the cyst, towards the medulla oblongata, a loose piece of carious bone, the size perhaps of half a filbert, rolled out of the medullary cavity. In the course of a careful dissection, another piece, much larger than the first, also loose and carious on all sides, was found. These were the remnants of the odontoid process, and of the body of the axis which was entirely destroyed or removed with the exception of a small lamina on the left side, which still remained attached to the semicircle of bone. The inferior articulating process on the right side was carious. The superior articulating process on the same side, and the transverse process with its vertebral foramen, were destroyed. The superior articulating process on the left side was carious, its articulating cartilage and capsular ligament had disappeared, and the caries extended over the lamella towards the posterior arch. Ascending to the atlas, the disease had destroyed both inferior articulating cartilages, and partially the processes, extending anteriorly round the condyles, upwards towards the superior condyles, and posteriorly through the left lamina of the posterior arch, breaking entirely through it at one point, and continuing on until it involved the posterior tubercle. In the occipital bone, the right articulating condyle and the basilar process were roughened, and in some places the continuity of the bone was destroyed.

"The apex of the odontoid was found suspended by its alar ligaments in its normal situation. The occipito-axoid ligament which incloses the odontoid process was ulcerated through, thus permitting the

fragments of this process to find their way into the vertebral canal. This process had been twice broken; once from its apex, which had been left adhering by its ligaments to the margin of the foramen-magnum, and once at its base, from the body of the dentatus, which had likewise separated from the rest of the bone.

"It is evident that one of these fractures must have occurred at the time when a crack was heard and felt in the neck, followed by immediate luxation and the symptoms previously described.

"The anterior face of the body of the third vertebra was also affected with caries, and the intervertebral substance almost completely destroyed, together with a part of its right articular process, and the whole of its anterior pedicle, which should have inclosed the vertebral foramen.

"Softening had likewise commenced in the cartilage between the bodies of most of the other cervical bones. Some, when in a fresh state, presented examples of central softening; and others, of well-defined ulcerated perforations, illustrative of the earliest stages of the disease when commencing in this part. The body of the sixth was deeply corroded, and the transverse processes of the seventh somewhat so. There was a remarkable, almost translucent, thinness of some parts of the os occipitis.

"The medullary substance in the cervical region was softened from the foramen-magnum to the first dorsal. The upper part was reduced to a pultaceous, semi-fluid mass. The medulla oblongata remained of its natural consistence and appearance. The brain

was healthy. Tubercles were found in the lungs, and strong, old pleuritic adhesion on both sides." *

Disease of the spine is, for the most part, the result of injury, through which inflammatory action is set up. Disease extends to the intervertebral substances and to the bodies of the vertebræ; so that in its mode of progress this form of inflammation does not materially differ from that which is observed to take place in other articulations. In all strumous affections of bone tubercular matter is deposited in the medullary cavities and in the cancellous structure of the bones; but the bodies of the vertebræ, from their spongy texture, and also by reason of the accidents to which the spinal column is liable, are in a special manner prone to this condition of disease—scrofulous caries.

In an early stage of the disease, one spot in the course of the vertebral column is more or less acutely sensitive. After a time the character of the pain is altered, and a slight projection of a spinous process or irregularity of two or three processes may be observed, with, perhaps, some tumefaction around the seat of disease. Caries may then be said to be established; and the structure of one or more vertebræ having become disorganized, a gap of greater or less extent, according to the number of bodies of vertebræ involved in the disease, is formed, and the upper portion of the column falls forward. That vertebra whose body has been most excavated becomes the most prominent, and its spinous process forms the apex of the angular projection. And, the deformity

* 'American Journal of the Medical Sciences.'

which ensues is greatest in the dorsal, and least in the lumbar region. But the greatest deformity from an equal amount of destruction occurs in the upper dorsal region. This is due to the shape of the vertebræ as well as to the formation of the vertebral curves; for the bodies of the dorsal vertebræ and the intervertebral substances of this region are thicker behind than in front, or the reverse of that which obtains in the cervical and in the lumbar regions, and the dorsal spine presenting its convexity backward, deformity is necessarily greater in this than in the cervical or the lumbar regions. But, also, the dorsal spines are long and superficial; and thus any increase of the curve increases the prominence of the spinous processes; and loss of substance, though it may be to a small extent only, produces greater deformity in the dorsal than in either of the other regions, and is immediately followed by angular appearance of the spine. On the other hand, in the lumbar region, the vertebræ allow of considerable loss of substance with comparatively small deformity, for they present a concavity backwards with short spinous processes which are buried among powerful muscles, while the bodies are broad and deep.

When disease is established in the cervical region, the head is somewhat thrown back, and is more or less fixed; and the muscles are thrown into action to prevent motion and to avoid pain, while the head seems to subside on to the shoulders. Thus the space is contracted between the occiput and the back. This is especially observable in children; but it may also be noticed in adults. Also, the muscles of one side of the neck are sometimes more contracted

than on the opposite side, and the head is in consequence inclined to one side or the other, as in wry-neck. This occurred in the following case.

Caroline S—, aged forty-three, was admitted into Princess's ward, with her head firmly fixed and inclined to the right side: the ear was drawn towards the right shoulder, and the chin was projected in the opposite direction. The muscles on both sides of the neck were rigid, but they were much more contracted on the right than on the left side. Such, then, was the condition of the head when the patient entered the hospital. After the head had been efficiently supported for some few days, the muscles became relaxed and the wry-neck had disappeared, for the irritation had ceased.

Pain is a very variable symptom of this disease. When the ligaments are first affected, pain is acute: every movement causes pain. At length less pain is experienced, and finally it almost disappears. Pain, however, may be excited by pressure on the diseased bone or by percussion, so long as inflammatory action exists in the affected part. To prevent the pain which is caused by motion, the child will move about with the hands resting on the thighs or on the knees, and will stand with the hands or the elbows resting on a table; thus to diminish the friction which is occasioned by one portion of the spinal column moving upon the other. But, also, this position is adopted for the sake of the support which is afforded by it, and that the superincumbent weight may thus be in some measure removed from the diseased bone. At the same time the muscles of the back are thrown

into action to fix as much as possible the affected parts, and thus to prevent movement and the pain which is caused by movement; in the same manner as is observed in all disease of articular surfaces. Muscular rigidity takes place to a much greater extent in the cervical than in the other regions of the spine; and probably because in a normal condition the mobility of the cervical portion is greater than that of any other portion of the spine.

As the substance of one or more of the bodies of the vertebræ is removed by caries, the upper portion of the column falls forward upon the lower. This displacement occurs in consequence of the chasm which has been produced in the column; so that the upper portion may be said to be left unsupported, and therefore it falls forward. And such muscles as the psoas assist in this action, when they become irritated. Although in the beginning of the disease the muscles of the back are rigid and tend to fix the spinal column and prevent motion so long as pain exists, they become atrophied in an advanced stage of the disease, when displacement has taken place.

The amount of angular deformity which takes place depends, first, on the extent to which the bodies of the vertebræ may be destroyed, and, secondly, on the position of the disease. But the extent of the disease, and consequently the amount of deformity, depend on the treatment to which the patient may have been subjected. It is possible that little or no apparent deformity shall remain, even when the upper dorsal region has been affected. Disease must then have been grappled with, however, at an early stage, and perseveringly.

When several vertebræ become affected, so that the chasm in the column which results is considerable, an angle more or less acute is produced, and the canal itself may be encroached upon. This encroachment may occasion pressure on the cord; and should it take place suddenly or increase rapidly, it will be followed by paralysis. When, however, deformity increases slowly, the cord becomes so tolerant of pressure that perhaps loss of power will not ensue. In these cases, partial paralysis is apt to occur when motion is permitted. And, again, power will be restored by continued rest of the body. There was lately, in Drummond ward, an instance in point. In this case disease was limited to the lower dorsal region, and there was very slight displacement; so little, indeed, was there, that when lying down scarcely any projection of the spinous processes could be observed. It was, however, conspicuous enough when the patient stood up. It was not possible to keep this patient always lying down: she would occasionally get out of bed. And when this occurred, violent twitchings of the lower limbs followed these efforts, and they lasted, perhaps with acute pain, for twenty-four or more hours, when they ceased, and the limbs again became motionless and flexed upon the trunk: then gradually the muscles relaxed and the limbs resumed their normal condition, and motion and sensation were again perfectly restored. This is not altogether an ordinary case, but I allude to it inasmuch as it illustrates certain points in the course of spinal disease.

In the case from which Fig. 77 was taken the bodies of at least five or six vertebræ were

entirely destroyed; but, notwithstanding the great deformity which was produced, symptoms of compression of the cord were never experienced.

For the most part, when destruction of the bodies of the vertebræ has taken place rapidly, paraplegia

Fig. 77.

is more or less complete; especially this is the case if movements of the body are permitted. But when caries has advanced slowly, little or no muscular weakness may result. Whenever motion is allowed in disease of the spine, a sense of weakness or pain is experienced at the seat of disease; and this is always increased by percussion or by firm pressure. Somewhat later, painful twitchings are produced by

movements of the trunk, and afterwards sensation becomes somewhat blunted. Tenderness begins to be felt in the course of the psoas muscle, or otherwise in the loins or in the neck, according to the seat of disease; and presently a slight swelling, communicating a doughy sensation, may be perceived, which increases according to circumstances to larger dimensions.

When paralysis occurs, motion is first lost, and subsequently sensation; and it occurs thus for the obvious reason that the anterior columns of the cord, which give off the nerves of motion, are more subjected to pressure and irritation, lying, as they do, more immediately in contact with the carious bone, than the posterior columns, from which the nerves of sensation are given off. Paralysis is not, however, as I have already shown, in proportion to the amount of deformity, but rather in proportion to the rapidity of the change which is effected.

When disease occurs in the lumbar region, it is sometimes attended with considerable pain, but rarely with much deformity. In the dorsal region, the great length of the spinous processes, and the forward curve which this portion of the column naturally assumes, tend to make any projection of the dorsal spine remarkable. The thorax, also, undergoes considerable change in its external form: the sternum is rendered prominent, while the ribs are compressed laterally, and project backwards together with the vertebræ. In such cases, the least hurry or excitement causes palpitation.

When disease occurs in the cervical region, the head may be held forward or it may be turned to one

side or the other and so be fixed, as in wry-neck. And, indeed, disease in this region may so closely simulate ordinary wry-neck that an error of diagnosis may easily be committed. Generally, however, the head falls back, and the child is unable to raise it. In these cases, any movement of the head, especially sudden or rotatory movements, cause excruciating pain; and even sudden death has been occasioned by such movements—namely, in cases where the atlas and the axis were involved in the disease. Under such circumstances the spinal cord in its specially vital portion may be crushed between the atlas and the odontoid process.* Occasionally, two portions of the spinal column are simultaneously attacked with caries. Such cases are rare, however, and their treatment differs in nothing from others which are more simple.

Spinal abscess, when it forms in the cervical region, presents itself between the muscles at the side of the neck, or the pus may burrow somewhat lower down, and the abscess will then probably point opposite to the dorsal vertebræ. And when the dorsal vertebræ are affected with disease, the pus either gravitates in the course of the posterior mediastinum, and passes along the psoas muscle, to point in the groin, whence it may burrow even to the knee; or the abscess, being deflected backwards, will appear in the loin, when it is known as lumbar abscess. Again, the pus may pass along an intercostal space, and come to the surface on the side of the thorax; or it may burst into the intestine, as,

* For a case of this description which occurred in the hospital, see 'Surgical Treatment of Children's Diseases,' p. 542, Holmes.

for instance, into the sigmoid flexure of the colon, and be evacuated *per rectum*. Under such circumstances I have known the patient to sink in the course of some few hours. Insensibility may ensue immediately on such a discharge taking place, and death may follow in two or three hours after. But instead of finding its way beneath Poupart's ligament, the pus may be arrested in its course, and collect in the iliac fossa, where it is sometimes found in large quantities. These results are induced by motion: it is obvious, therefore, how they should be avoided.

Treatment.—The treatment of disease of the spine does not differ materially from that which is indicated for scrofulous joints generally—namely, rest of the part affected.

A limb may be kept at rest by means of a suitable splint, and when the joint is thus secured, the patient can move about without fear of injury, so long as the limb is not used. It is not so, however, with the spine. Only the posterior surface of the spine can be efficiently supported, and therefore the trunk cannot be perfectly fixed nor can friction of the opposed surfaces of the carious bodies of the vertebræ be prevented, except in the recumbent position. This position, then, should be constantly observed in disease of the spine. But this is not alone sufficient; for it is required, also, to keep the trunk motionless, so that friction of the diseased surfaces shall be avoided. And this can only be effected by means of a well-adapted splint which shall grasp the pelvis and shoulders and perhaps also the neck and occiput. As a further precaution, the mattress on which the patient lies may be slightly

hollowed to receive the splint. The most convenient couch for long-continued recumbency is a double inclined plane; by means of which the shoulders and knees may be gently raised or lowered at pleasure. Such movements add greatly to the comfort of the patient.

The supine is preferable to the prone position, for it can be continued longer without movement, and is, therefore, more favorable to ankylosis. But whatever the posture may be, absolute rest in the recumbent position is an undoubted necessity. Professor Pirrie has put this point well. He says, "Rest of the diseased parts and the recumbent position, whether the body be prone or supine, are of the utmost importance from the very commencement of the disease, until a cure is effected by ankylosis."*

The importance of this fact—rest in the recumbent position—cannot be too much insisted on. Without it, all other treatment is useless. I have never known an abscess to form when this treatment has been strictly carried out; but on the other hand I have often known an abscess to be absorbed when the recumbent position has been strictly maintained.

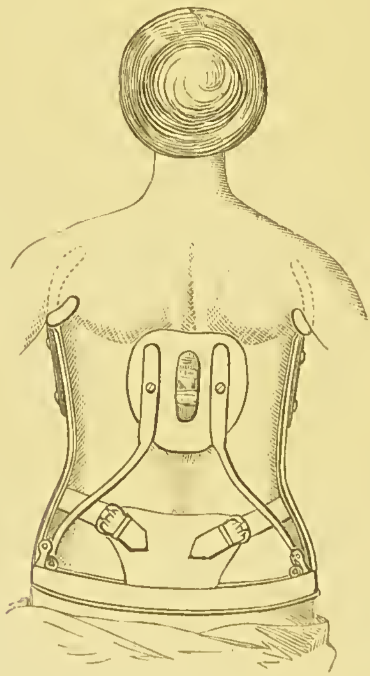
The time which is required for this absolute rest depends on the previous duration of disease: probably eight or ten months may be sufficient when treatment is undertaken at an early period; but the necessary time will increase in proportion as disease has advanced. Without rest in the recumbent position, ankylosis can never take place.

Ankylosis, then, is the cure to be effected. And

* 'Principles of Surgery,' Second Edition, p. 463.

when this has taken place, a portable instrument may be worn to support the spine and to remove the weight of the head and shoulders. The form of instrument which is generally used is shown in Fig. 78. After the upright position has been resumed, two incurvations of the spine will be observed—one above and the other below the seat of disease.

Fig. 78.



These are essential for equilibrium; and they can only be formed after ankylosis has taken place. Thus these curves become proofs that ankylosis is more or less complete.

There is a spurious as well as a true ankylosis, however. This consists of ossific union in the course of the posterior surface of the spinal column.

It consists for the most part of a thin plate of bone only, which is insufficient to fill up the space caused by the removal of the diseased vertebral bodies; and being slender it is liable with only slight exertion to snap. This form of union is promoted by the use of the prone couch.

When unfortunately, pus accumulates in such quantity that an abscess shows itself externally, whether in the groin, the loin, or elsewhere, it should never be allowed to open spontaneously, but the contents of the sac should be evacuated by means of the aspirator. Thus tension having been removed by the withdrawal of pus the opening may be closed. This operation may be repeated as it becomes necessary. Without motion, probably the abscess would not have formed. If motion be allowed after the abscess has been emptied, it will again fill. It will probably refill after it has been emptied, even though perfect quiet be observed, so that it is not unlikely that the aspirator may have to be used three or four or more times. Therefore, whether before the formation of abscess or after its evacuation, the rule for our guidance in these cases is always the same —rest in the recumbent position.

The following cases will place in a sufficiently strong light the advantage of complete rest:

In May, 1858, I saw with Sir George Burrows, Mr Else, and Mr Sargent, a gentleman 26 years of age, who, while riding in Ireland to Parsonstown, met with an injury to the spine through the stumbling of his horse. He was severely jerked, and immediately after pain was felt at the junction of the cervical with the dorsal vertebræ. He continued his ride

notwithstanding; and subsequently walked through a part of Ireland. This took place in September, 1857. He returned home complaining of pain in his neck; but continued to move about as formerly, rejecting the advice which was offered him. In January, 1858, pain had increased considerably. Then he began to see the necessity of lying down; but even at this time he rose often from his couch to walk from room to room.

In May, I found the fourth dorsal vertebra prominent and carious, and the seventh cervical unusually movable. I insisted strongly, as had been done before, on perfect recumbency, but in vain: he would invariably walk from room to room when he considered it necessary. In July, the power of the lower limbs was partially lost, and also the command of the sphincter ani. In August, the intercostal muscles became paralysed, and he died in September.

Sir William Gull, who had seen him previously, was present at the *post-mortem* examination and wrote to me thus:—"The intervertebral cartilage, between the fourth and fifth dorsal vertebræ, was destroyed, and the adjacent bodies were extensively carious." And in addition, Mr Sargent remarked "that a portion of the body of the fourth dorsal vertebra came away as if it were completely detached, and the medulla spinalis was compressed and softened for the space of one inch."

In August, 1861, I saw, with Dr Beale and with the patient's father, a medical practitioner at Liverpool, and subsequently with Dr Little, a gentleman 26 years of age, who two years previously had hurt his back while stooping. His back had remained

"stiff" since that time. When I saw him the four lower dorsal vertebræ were carious, and an abscess occupied the lumbar region. He had just taken his passage to China, but was at once told that he must give up the idea of going to China, and that he must lie down without moving. When he was fully satisfied of the necessity of this measure he carried it out with such a firm will that he scarcely moved until firm ankylosis had taken place. This occupied three years. All pain subsided, and his general health improved in a short time after he began to lie down. In the course of ten months the abscess had entirely disappeared. At length he was upright and strong and tolerably active, with scarcely any projection of the vertebræ. In 1869 he married.

Such, then, is the mode of treatment to be adopted in these cases of disease of the spine, where the surgeon can do so little for his patient, but nature so much if rightly directed. When the recumbent position is maintained until ankylosis is complete, the future of such a patient may be as useful, and I might almost say as vigorous, as though disease had not occurred. But that this may result, treatment must have commenced early, and have been insisted on resolutely. There can be no dallying with this form of disease. If the patient and the surgeon are together resolved that there shall be no movements of the body until ankylosis is complete, the patient will rise from his couch fit almost for the enjoyment of life; and if there has been no rising on the elbow and no walking, but absolute and continued inaction during the whole period of lying down, the future of such an one will probably be scarcely less vigorous

than it would have been had he not suffered from caries of the spine.

There is no difficulty in carrying out this treatment with children. The improvement that takes place is immediately obvious, so that a parent is anxious to continue it. Nor is there difficulty either when the patient is older. The treatment will scarcely have commenced before all the painful symptoms of the disease will have diminished, and in the course of some few weeks or months pain will probably have ceased entirely, and the functions of the body will be performed as in health.

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

London, New Burlington Street,
February, 1876.

SELECTION

FROM

MESSRS J. & A. CHURCHILL'S

General Catalogue

COMPRISING

ALL RECENT WORKS PUBLISHED BY THEM

ON THE

ART AND SCIENCE

OF

MEDICINE

THE PRACTICE OF SURGERY:
a Manual by THOMAS BRYANT, F.R.C.S., Surgeon to Guy's Hospital. Crown 8vo, with 507 Engravings, 21s. [1872]

THE PRINCIPLES AND PRACTICE OF SURGERY
by WILLIAM PIRRIE, F.R.S.E., Professor of Surgery in the University of Aberdeen. Third Edition, 8vo, with 490 Engravings, 28s. [1873]

A SYSTEM OF PRACTICAL SURGERY
by Sir WILLIAM FERGUSSON, Bart., F.R.C.S., F.R.S., Serjeant-Surgeon to the Queen. Fifth Edition, 8vo, with 463 Engravings, 21s. [1870]

OPERATIVE SURGERY
by C. F. MAUNDER, F.R.C.S., Surgeon to the London Hospital, formerly Demonstrator of Anatomy at Guy's Hospital. Second Edition, post 8vo, with 164 Engravings, 6s. [1872]

BY THE SAME AUTHOR.

SURGERY OF THE ARTERIES:
Lettsomian Lectures for 1875, on Aneurisms, Wounds, Hæmorrhages, &c. Post 8vo, with 18 Engravings, 5s. [1875]

THE SURGEON'S VADE-MECUM
by ROBERT DRUITT. Tenth Edition, fcap. 8vo, with numerous Engravings, 12s. 6d. [1870]

THE SCIENCE AND PRACTICE OF SURGERY:
a complete System and Textbook by F. J. GANT, F.R.C.S., Surgeon to the Royal Free Hospital. 8vo, with 470 Engravings, 24s. [1871]

OUTLINES OF SURGERY AND SURGICAL PATHOLOGY
including the Diagnosis and Treatment of Obscure and Urgent Cases, and the Surgical Anatomy of some Important Structures and Regions, by F. LE GROS CLARK, F.R.S., Consulting Surgeon to St. Thomas's Hospital. Second Edition, Revised and Expanded by the Author, assisted by W. W. WAGSTAFFE, F.R.C.S., Assistant-Surgeon to, and Joint-Lecturer on Anatomy at, St. Thomas's Hospital. 8vo, 10s. 6d. [1872]

CLINICAL AND PATHOLOGICAL OBSERVATIONS IN INDIA
by Sir J. FAYRER, K.S.I., M.D., F.R.C.P. Lond., F.R.S.E., Honorary Physician to the Queen. 8vo, with Engravings, 20s. [1873]

SURGICAL EMERGENCIES

together with the Emergencies attendant on Parturition and the Treatment of Poisoning: a Manual for the use of General Practitioners, by WILLIAM P. SWAIN, F.R.C.S., Surgeon to the Royal Albert Hospital, Devonport. Fcap. 8vo, with 82 Engravings, 6s. [1874]

BY THE SAME AUTHOR.

INJURIES AND DISEASES OF THE KNEE-JOINT

and their Treatment by Amputation and Excision Contrasted: Jacksonian Prize Essay. 8vo, with 36 Engravings, 9s. [1869]

ILLUSTRATIONS OF CLINICAL SURGERY,

consisting of Plates, Photographs, Woodcuts, Diagrams, &c., illustrating Surgical Diseases, Symptoms and Accidents; also Operations and other methods of Treatment. By JONATHAN HUTCHINSON, F.R.C.S., Senior Surgeon to the London Hospital. In Quarterly Fasciculi. Fasc. I and II already issued. 6s. 6d. each. [1875]

FRACTURES OF THE LOWER END OF THE RADIUS,

Fractures of the Clavicle, and on the Reduction of the Recent Inward Dislocations of the Shoulder Joint. By ALEXANDER GORDON, M.D., Professor of Surgery in Queen's College, Belfast. With Engravings, 8vo, 5s. [1875]

MINOR SURGERY AND BANDAGING

a Manual for the Use of House-Surgeons, Dressers, and Junior Practitioners, by CHRISTOPHER HEATH, F.R.C.S., Surgeon to University College Hospital. Fifth Edition, fcap 8vo, with 86 Engravings, 5s. 6d. [1875]

BY THE SAME AUTHOR,

INJURIES AND DISEASES OF THE JAWS:

JACKSONIAN PRIZE ESSAY. Second Edition, 8vo, with 164 Engravings, 12s. [1872]

DICTIONARY OF PRACTICAL SURGERY

and Encyclopædia of Surgical Science, by SAMUEL COOPER. New Edition, brought down to the present Time by SAMUEL A. LANE, Consulting Surgeon to St. Mary's and to the Lock Hospitals; assisted by various Eminent Surgeons. 2 vols. 8vo, 50s. [1861 and 1872]

THE FEMALE PELVIC ORGANS

their Surgery, Surgical Pathology, and Surgical Anatomy, in a Series of Coloured Plates taken from Nature: with Commentaries, Notes, and Cases, by HENRY SAVAGE, M.D. Lond., F.R.C.S., Consulting Officer of the Samaritan Free Hospital Third Edition, 4to, £1 15s. [1875]

FRACTURES OF THE LIMBS

(Treatment of) by J. SAMPSON GAMGEE, Surgeon to the Queen's Hospital, Birmingham. 8vo, with Plates, 10s. 6d. [1871]

DISEASES AND INJURIES OF THE EAR

by W. B. DALBY, F.R.C.S., M.B., Aural Surgeon and Lecturer on Aural Surgery at St. George's Hospital. Crown 8vo, with 21 Engravings, 6s. 6d. [1873]

AURAL CATARRH;

or, the Commonest Forms of Deafness, and their Cure, by PETER ALLEN, M.D., F.R.C.S.E., late Aural Surgeon to St. Mary's Hospital. Second Edition, crown 8vo, with Engravings, 8s. 6d. [1874]

PRINCIPLES OF SURGICAL DIAGNOSIS

especially in Relation to Shock and Visceral Lesions, Lectures delivered at the Royal College of Surgeons by F. LE GROS CLARK, F.R.C.S., Consulting Surgeon to St. Thomas's Hospital. 8vo, 10s. 6d. [1870]

CLUBFOOT:

its Causes, Pathology, and Treatment; being the Jacksonian Prize Essay by WM. ADAMS, F.R.C.S., Surgeon to the Great Northern Hospital. Second Edition, 8vo, with 106 Engravings and 6 Lithographic Plates, 15s. [1873]

DEFORMITIES OF THE HUMAN BODY:

a System of Orthopædic Surgery, by BERNARD E. BRODHURST, F.R.C.S., Surgeon to the Royal Orthopædic Hospital. 8vo, with Engravings, 10s. 6d. [1871]

OPERATIVE SURGERY OF THE FOOT AND ANKLE

by HENRY HANCOCK, F.R.C.S., Consulting Surgeon to Charing Cross Hospital. 8vo, with Engravings, 15s. [1873]

THE TREATMENT OF SURGICAL INFLAMMATIONS

by a New Method, which greatly shortens their Duration, by FURNEAUX JORDAN, F.R.C.S., Professor of Surgery in Queen's College, Birmingham. 8vo, with Plates, 7s. 6d. [1870]

BY THE SAME AUTHOR,

SURGICAL INQUIRIES

With numerous Lithographic Plates. 8vo, 5s. [1873]

INTERNAL ANEURISM:

Successful Treatment of, by Consolidation of the Contents of the Sac. By T. JOLIFFE TUFNELL, F.R.C.S.I., President of the Royal College of Surgeons in Ireland. With Coloured Plates. Second Edition, royal 8vo, 5s. [1875]

HERNIAL AND OTHER TUMOURS
of the Groin and its Neighbourhood, with some Practical Remarks on the Radical Cure of Ruptures, by C. HOLTHOUSE, F.R.C.S., Surgeon to the Westminster Hospital. 8vo, 6s. 6d. [1870]

THE SURGERY OF THE RECTUM:
Lettsomian Lectures by HENRY SMITH, F.R.C.S., Surgeon to King's College Hospital. Third Edition, fcap 8vo, 3s. 6d. [1871]

FISTULA, HÆMORRHOIDS, PAINFUL ULCER,
Stricture, Prolapsus, and other Diseases of the Rectum: their Diagnosis and Treatment, by WM. ALLINGHAM, F.R.C.S., Surgeon to St. Mark's Hospital for Fistula, &c., late Surgeon to the Great Northern Hospital. Second Edition, 8vo, 7s. [1872]

THE URINE AND ITS DERANGEMENTS
with the Application of Physiological Chemistry to the Diagnosis and Treatment of Constitutional as well as Local Diseases. Lectures by GEORGE HARLEY, M.D., F.R.S., F.R.C.P., formerly Professor in University College. Post 8vo, 9s. [1872]

STRICTURE OF THE URETHRA
and Urinary Fistulæ; their Pathology and Treatment: Jacksonian Prize Essay by Sir HENRY THOMPSON, F.R.C.S., Surgeon-Extraordinary to the King of the Belgians. Third Edition, 8vo, with Plates, 10s. [1869]

BY THE SAME AUTHOR,

PRACTICAL LITHOTOMY AND LITHOTRITY;
or, An Inquiry into the best Modes of removing Stone from the Bladder. Second Edition, 8vo, with numerous Engravings. 10s. [1871]

ALSO,

DISEASES OF THE URINARY ORGANS
(Clinical Lectures). Third Edition, crown 8vo, with Engravings, 6s. [1872]

ALSO,

DISEASES OF THE PROSTATE:
their Pathology and Treatment. Fourth Edition, 8vo, with numerous Plates, 10s. [1873]

ALSO,

THE PREVENTIVE TREATMENT OF CALCULOUS DISEASE
and the Use of Solvent Remedies. Second Edition, fcap. 8vo, 2s. 6d. [1876]

STRICTURE OF THE URETHRA
(the Immediate Treatment of), by BARNARD HOLT, F.R.C.S., Consulting Surgeon to the Westminster Hospital. Third Edition, 8vo, 6s. [1868]

KIDNEY DISEASES, URINARY DEPOSITS
and Calculous Disorders by LIONEL S. BEALE, M.B., F.R.S., F.R.C.P., Physician to King's College Hospital. Third Edition, 8vo, with 70 Plates, 25s. [1868]

THE IRRITABLE BLADDER:
its Causes and Treatment, by F. J. GANT, F.R.C.S., Surgeon to the Royal Free Hospital. Third Edition, crown 8vo, with Engravings, 6s. [1872]

RENAL DISEASES:
a Clinical Guide to their Diagnosis and Treatment by W. R. BASHAM, M.D., F.R.C.P., Senior Physician to the Westminster Hospital. Post 8vo, 7s. [1870]

BY THE SAME AUTHOR,

THE DIAGNOSIS OF DISEASES OF THE KIDNEYS
(Aids to). 8vo, with 10 Plates, 5s. [1872]

MICROSCOPIC STRUCTURE OF URINARY CALCULI
by H. V. CARTER, M.D., Surgeon-Major, H.M.'s Bombay Army. 8vo, with 4 Plates, 5s. [1873]

THE REPRODUCTIVE ORGANS
in Childhood, Youth, Adult Age, and Advanced Life (Functions and Disorders of), considered in their Physiological, Social, and Moral Relations, by WILLIAM ACTON, M.R.C.S. Sixth Edition, 8vo, 12s. [1875]

URINARY AND REPRODUCTIVE ORGANS
(Functional Diseases of) by D. CAMPBELL BLACK, M.D., L.R.C.S. Edin. Second Edition. 8vo, 10s. 6d. [1875]

BY THE SAME AUTHOR.

LECTURES ON BRIGHT'S DISEASE
delivered at the Royal Infirmary of Glasgow. 8vo, with 20 Engravings, 6s. 6d. [1875]

GENITO-URINARY ORGANS, INCLUDING SYPHILIS
A Practical Treatise on their Surgical Diseases, designed as a Manual for Students and Practitioners, by W. H. VAN BUREN, M.D., Professor of the Principles of Surgery in Bellevue Hospital Medical College, New York, and E. L. KEYES, M.D., Professor of Dermatology in Bellevue Hospital Medical College, New York. Royal 8vo, with 140 Engravings, 21s. [1874]

SYPHILIS
A Treatise by WALTER J. COULSON, F.R.C.S., Surgeon to the Lock Hospital. 8vo, 10s. [1869]

BY THE SAME AUTHOR,

STONE IN THE BLADDER:
Its Prevention, Early Symptoms, and Treatment by Lithotrity. 8vo, 6s. [1868]

PRACTICAL PATHOLOGY:
containing Lectures on Suppurative Fever, Diseases of the Veins, Hæmorrhoidal Tumours, Diseases of the Rectum, Syphilis, Gonorrheal Ophthalmia, &c., by HENRY LEE, F.R.C.S., Surgeon to St. George's Hospital. Third Edition, in 2 vols. 8vo, 10s. each. [1870]

BY THE SAME AUTHOR,

LECTURES ON SYPHILIS,
and on some forms of Local Disease, affecting principally the Organs of Generation. With Engravings, 8vo, 10s. [1875]

SYPHILITIC NERVOUS AFFECTIONS
(Clinical Aspects of) by THOMAS BUZZARD, M.D., F.R.C.P. Lond., Physician to the National Hospital for Paralysis and Epilepsy. Post 8vo, 5s. [1874]

SYPHILITIC OSTEITIS AND PERIOSTITIS
Lectures by JOHN HAMILTON, F.R.C.S.I., Surgeon to the Richmond Hospital and to Swift's Hospital for Lunatics, Dublin. 8vo, with Plates, 6s. 6d. [1874]

PRINCIPLES OF HUMAN PHYSIOLOGY
by W. B. CARPENTER, M.D., F.R.S. Eighth Edition by HENRY POWER, M.B., F.R.C.S., Examiner in Natural Science, University of Oxford, and in Natural Science and Medicine, University of Cambridge. 8vo, with 3 Steel Plates and 371 Engravings, 31s. 6d. [1876]

HUMAN PHYSIOLOGY:
A Treatise designed for the Use of Students and Practitioners of Medicine, by JOHN C. DALTON, M.D., Professor of Physiology and Hygiene in the College of Physicians and Surgeons, New York. Sixth Edition, royal 8vo, with 316 Engravings, 20s. [1875]

HANDBOOK FOR THE PHYSIOLOGICAL LABORATORY
by E. KLEIN, M.D., F.R.S., Assistant Professor in the Pathological Laboratory of the Brown Institution, London; J. BURDON-SANDERSON, M.D., F.R.S., Professor of Practical Physiology in University College, London; MICHAEL FOSTER, M.D., F.R.S., Prælector of Physiology in Trinity College, Cambridge; and T. LAUDER BRUNTON, M.D., D.Sc., Lecturer on Materia Medica at St. Bartholomew's Hospital; edited by J. BURDON-SANDERSON. 8vo, with 123 Plates, 24s. [1873]

HISTOLOGY AND HISTO-CHEMISTRY OF MAN
A Treatise on the Elements of Composition and Structure of the Human Body, by HEINRICH FREY, Professor of Medicine in Zurich. Translated from the Fourth German Edition by ARTHUR E. J. BARKER, Assistant-Surgeon to University College Hospital. And Revised by the Author. 8vo, with 608 Engravings, 21s. [1874]

§

PRACTICAL HISTOLOGY
(Outlines of) by WILLIAM RUTHERFORD, M.D., Professor of the Institutes of Medicine in the University of Edinburgh. With Engravings. Crown 8vo, interleaved, 3s. [1875]

THE MARRIAGE OF NEAR KIN
Considered with respect to the Laws of Nations, Results of Experience, and the Teachings of Biology, by ALFRED H. HUTH. 8vo, 14s. [1875]

STUDENTS' GUIDE TO HUMAN OSTEOLOGY
By WILLIAM WARWICK WAGSTAFFE, F.R.C.S., Assistant-Surgeon and Lecturer on Anatomy, St. Thomas's Hospital. With 23 Plates and 66 Engravings. Fcap. 8vo, 10s. 6d. [1875]

HUMAN OSTEOLOGY:
with Plates, showing the Attachments of the Muscles, by LUTHER HOLDEN, F.R.C.S., Surgeon to St. Bartholomew's Hospital. Fourth Edition, 8vo, 16s. [1869]

BY THE SAME AUTHOR,

THE DISSECTION OF THE HUMAN BODY
(A Manual). Third Edition, 8vo, with Engravings, 16s. [1868]

MEDICAL ANATOMY
by FRANCIS SIBSON, M.D., F.R.C.P., F.R.S., Consulting Physician to St. Mary's Hospital. Imp. folio, with 21 coloured Plates, cloth, 42s.; half-morocco, 50s. [Completed in 1869]

THE CIRCULATION OF THE BLOOD
(Forces which carry on) by ANDREW BUCHANAN, M.D., Professor of Physiology in the University of Glasgow. Second Edition, 8vo, with Engravings, 5s. [1874]

PATHOLOGICAL ANATOMY
Lectures by SAMUEL WILKS, M.D., F.R.S., Physician to, and Lecturer on Medicine at, Guy's Hospital; and WALTER MOXON, M.D., F.R.C.P., Physician to, and Lecturer on Materia Medica at, Guy's Hospital. Second Edition, 8vo, with Plates, 18s. [1875]

PATHOLOGICAL ANATOMY
A Manual by C. HANDFIELD JONES, M.B., F.R.S., Physician to St. Mary's Hospital, and EDWARD H. SIEVEKING, M.D., F.R.C.P., Physician to St. Mary's Hospital. Edited by J. F. PAYNE, M.D., F.R.C.P., Assistant Physician and late Demonstrator of Morbid Anatomy at St. Thomas's Hospital. Second Edition, crown 8vo, with nearly 200 Engravings, 16s. [1875]

STUDENT'S GUIDE TO SURGICAL ANATOMY:
a Text-book for the Pass Examination, by E. BELLAMY, F.R.C.S., Senior Assistant-Surgeon and Lecturer on Anatomy at Charing Cross Hospital. Fcap 8vo, with 50 Engravings, 6s. 6d. [1873]

THE ANATOMIST'S VADE-MECUM:
a System of Human Anatomy by ERASMUS WILSON, F.R.C.S., F.R.S. Ninth Edition, by Dr. G. BUCHANAN, Professor of Anatomy in Anderson's University, Glasgow. Crown 8vo, with 371 Engravings, 14s. [1873]

PRACTICAL ANATOMY:
a Manual of Dissections by CHRISTOPHER HEATH, F.R.C.S., Surgeon to University College Hospital. Third Edition, fcap 8vo, with 226 Engravings, 12s. 6d. [1874]

DIAGRAMS OF THE NERVES OF THE HUMAN BODY
Exhibiting their Origin, Divisions, and Connexions, with their Distribution, by WILLIAM HENRY FLOWER, F.R.S., Conservator of the Museum of the Royal College of Surgeons. Second Edition, roy. 4to, 12s. [1872]

THE STUDENT'S GUIDE TO MEDICAL DIAGNOSIS
by SAMUEL FENWICK, M.D., F.R.C.P., Assistant Physician to the London Hospital. Third Edition, fcap 8vo, with 87 Engravings, 6s. 6d. [1873]

A MANUAL OF MEDICAL DIAGNOSIS
by A. W. BARCLAY, M.D., F.R.C.P., Physician to, and Lecturer on Medicine at, St. George's Hospital. Third Edition, fcap 8vo, 10s. 6d. [1870]

THE MEDICAL REMEMBRANCER;
or, Book of Emergencies. By E. SHAW, M.R.C.S. Fifth Edition by JONATHAN HUTCHINSON, F.R.C.S., Senior Surgeon to the London Hospital. 32mo, 2s. 6d. [1867]

THE ANATOMICAL REMEMBRANCER;
or, Complete Pocket Anatomist. Seventh Edition, 32mo, 3s. 6d. [1872]

ANTAGONISM OF MEDICINES
(Researches into the) being the Report of the Edinburgh Committee of the British Medical Association. By J. HUGHES BENNETT, M.D. Post 8vo, 3s. 6d. [1875]

HOOPER'S PHYSICIAN'S VADE-MECUM;
or, Manual of the Principles and Practice of Physic, Ninth Edition by W. A. GUY, M.B., F.R.S., and JOHN HARLEY, M.D., F.R.CP. Fcap 8vo, with Engravings, 12s. 6d. [1874]

CLINICAL MEDICINE
Lectures and Essays by BALTHAZAR FOSTER, M.D., F.R.C.P Lond., Professor of Medicine in Queen's College, Birmingham. 8vo, 10s. 6d. [1874]

DISCOURSES ON PRACTICAL PHYSIC
by B. W. RICHARDSON, M.D., F.R.C.P., F.R.S. 8vo, 5s. [1871]

ROYLE'S MANUAL OF MATERIA MEDICA AND THERAPEUTICS.
Sixth Edition by John Harley, M.D., Assistant Physician to, and Joint Lecturer on Physiology at, St. Thomas's Hospital. Crown 8vo, with 139 Engravings, 15s. [1876]

A DICTIONARY OF MATERIA MEDICA
and Therapeutics by Adolphe Wahltuch, M.D. 8vo, 15s. [1868]

MATERIA MEDICA AND THERAPEUTICS:
(Vegetable Kingdom), by Charles D. F. Phillips, M.D., F.R.C.S.E. 8vo, 15s. [1874]

PRACTICAL THERAPEUTICS
A Manual by E. J. Waring, M.D., F.R.C.P. Lond. Third Edition, fcap 8vo, 12s. 6d. [1871]

THE STUDENT'S GUIDE TO MATERIA MEDICA
by John C. Thorowgood, M.D. Lond., Physician to the City of London Hospital for Diseases of the Chest. Fcap 8vo, with Engravings, 6s. 6d. [1874]

THE DISEASES OF CHILDREN
A Practical Manual, with a Formulary, by Edward Ellis, M.D., Physician to the Victoria Hospital for Children. Second Edition, crown 8vo, 7s. [1873]

THE WASTING DISEASES OF CHILDREN
by Eustace Smith, M.D. Lond., Physician to the King of the Belgians, Physician to the East London Hospital for Children. Second Edition, post 8vo, 7s. 6d. [1870]

THE DISEASES OF CHILDREN
Essays by William Henry Day, M.D., Physician to the Samaritan Hospital for Diseases of Women and Children. Fcap 8vo, 5s. [1873]

COMPENDIUM OF CHILDREN'S DISEASES
A Handbook for Practitioners and Students, by Johann Steiner, M.D., Professor of the Diseases of Children in the University of Prague. Translated from the Second German Edition by Lawson Tait, F.R.C.S., Surgeon to the Birmingham Hospital for Women. 8vo, 12s. 6d. [1874]

OBSTETRIC SURGERY
A Complete Handbook, giving Short Rules of Practice in every Emergency, from the Simplest to the most Formidable Operations connected with the Science of Obstetricy, by Charles Clay, Ext.L.R.C.P. Lond., L.R.C.S.E., late Senior Surgeon and Lecturer on Midwifery, St. Mary's Hospital, Manchester. Fcap 8vo, with 91 Engravings, 6s. 6d. [1874]

THE STUDENT'S GUIDE TO THE PRACTICE OF MIDWIFERY
by D. LLOYD ROBERTS, M.D., Physician to St. Mary's Hospital, Manchester. Fcap. 8vo, with 95 Engravings, 6s. 6d. [1875]

PUERPERAL DISEASES
Clinical Lectures by FORDYCE BARKER, M.D., Obstetric Physician to Bellevue Hospital, New York. 8vo, 15s. [1874]

OBSTETRIC OPERATIONS,
including the Treatment of Hæmorrhage, and forming a Guide to the Management of Difficult Labour; Lectures by ROBERT BARNES, M.D., F.R.C.P., Obstetric Physician and Lecturer on Obstetrics and the Diseases of Women and Children to St. George's Hospital. Third Edition, 8vo, with 124 Engravings, 18s. [1875]

BY THE SAME AUTHOR,

MEDICAL AND SURGICAL DISEASES OF WOMEN
(a Clinical History). 8vo, with 169 Engravings, 28s. [1873]

OBSTETRIC MEDICINE AND SURGERY
(Principles and Practice of) by F. H. RAMSBOTHAM, M.D., F.R.C.P., Fifth Edition, 8vo, with 120 Plates, 22s. [1867]

OBSTETRIC APHORISMS
for the Use of Students commencing Midwifery Practice by J. G. SWAYNE, M.D., Consulting Physician-Accoucheur to the Bristol General Hospital, and Lecturer on Obstetric Medicine at the Bristol Medical School. Sixth Edition, fcap 8vo, with Engravings, 3s. 6d. [1876]

SCHROEDER'S MANUAL OF MIDWIFERY,
including the Pathology of Pregnancy and the Puerperal State. Translated by CHARLES H. CARTER, B.A., M.D. 8vo, with Engravings, 12s. 6d. [1873]

A HANDBOOK OF UTERINE THERAPEUTICS
and of Diseases of Women by E. J. TILT, M.D., M.R.C.P. Third Edition, post 8vo, 10s. [1868]

BY THE SAME AUTHOR,

THE CHANGE OF LIFE
in Health and Disease: a Practical Treatise on the Nervous and other Affections incidental to Women at the Decline of Life. Third Edition, 8vo, 10s. 6d. [1870]

DISEASES OF THE OVARIES:
their Diagnosis and Treatment, by T. SPENCER WELLS, F.R.C.S., Surgeon to the Queen's Household and to the Samaritan Hospital. 8vo, with about 150 Engravings, 21s. [1872]

HANDBOOK FOR NURSES FOR THE SICK
by ZEPHERINA P. VEITCH. Second Edition, crown 8vo, 3s. 6d. [1876]

A MANUAL FOR HOSPITAL NURSES
and others engaged in Attending on the Sick by EDWARD J. DOMVILLE, L.R.C.P., M.R.C.S. Second Edition, crown 8vo, 2s. 6d. [1875]

LECTURES ON NURSING
by William Robert Smith, L.R.C.S.E, Resident Surgeon, Royal Hants County Hospital, Winchester. With 26 Engravings. Post 8vo, 6s. [1875]

ENGLISH MIDWIVES:
their History and Prospects, by J. H. Aveling, M.D., Physician to the Chelsea Hospital for Women, Examiner of Midwives for the Obstetrical Society of London. Crown 8vo, 5s. [1872]

A COMPENDIUM OF DOMESTIC MEDICINE
and Companion to the Medicine Chest; intended as a Source of Easy Reference for Clergymen, and for Families residing at a Distance from Professional Assistance, by John Savory, M.S.A. Eighth Edition, 12mo, 5s. [1871]

THE WIFE'S DOMAIN
The Young Couple—The Mother—The Nurse—The Nursling, by Philothalos. Second Edition, post 8vo, 3s. 6d. [1874]

WINTER COUGH
(Catarrh, Bronchitis, Emphysema, Asthma), Lectures by Horace Dobell, M.D., Consulting Physician to the Royal Hospital for Diseases of the Chest. Third Edition, with Coloured Plates, 8vo, 10s. 6d. [1875]

BY THE SAME AUTHOR,

THE TRUE FIRST STAGE OF CONSUMPTION
(Lectures). Crown 8vo, 3s. 6d. [1867

DISEASES OF THE CHEST:
Contributions to their Clinical History, Pathology, and Treatment, by A. T. H. Waters, M.D., F.R.C.P., Physician to the Liverpool Royal Infirmary. Second Edition, 8vo, with Plates, 15s. [1873

PHTHISIS AND THE STETHOSCOPE;
or, the Physical Signs of Consumption, by R. P. Cotton, M.D., F.R.C.P., Senior Physician to the Hospital for Consumption, Brompton. Fourth Edition, fcap 8vo, 3s. 6d. [1869

PHTHISIS
In a series of Clinical Studies, by Austin Flint, M.D., Professor of the Principles and Practice of Medicine and of Clinical Medicine in the Bellevue Hospital Medical College. 8vo, 16s. [1875

DISEASES OF THE HEART
and of the Lungs in Connexion therewith—Notes and Observations by Thomas Shapter, M.D., F.R.C.P. Lond., Senior Physician to the Devon and Exeter Hospital. 8vo, 7s. 6d. [1874

DISEASES OF THE HEART
Their Pathology, Diagnosis, Prognosis, and Treatment (a Manual), by Robert H. Semple, M.D., F.R.C.P., Physician to the Hospital for Diseases of the Throat. 8vo, 8s. 6d. [1875

DISEASES OF THE HEART AND AORTA
By Thomas Hayden, F.K.Q.C.P. Irel., Physician to the Mater Misericordiæ Hospital, Dublin. With 80 Engravings. 8vo, 25s. [1875]

VALVULAR DISEASE OF THE HEART
(some of its causes and effects). Croonian Lectures for 1865. By Thomas B. Peacock, M.D., F.R.C.P., Physician to St. Thomas's Hospital. With Engravings, 8vo, 5s. [1865]

DISEASES OF THE HEART AND AORTA
Clinical Lectures by George W. Balfour, M.D., F.R.C.P., Physician to, and Lecturer on Clinical Medicine in, the Royal Infirmary, Edinburgh. 8vo, with Engravings, 12s. 6d. [1876]

THE ACTION AND SOUNDS OF THE HEART
Researches by George Paton, M.D., author of numerous papers published in the British and American Medical Journals. Re-issue, with Appendix, 8vo, 3s. 6d. [1874

NOTES ON ASTHMA;
its Forms and Treatment, by John C. Thorowgood, M.D. Lond., F.R.C.P., Physician to the Hospital for Diseases of the Chest, Victoria Park. Second Edition, crown 8vo, 4s. 6d. [1873]

GROWTHS IN THE LARYNX,
with Reports and an Analysis of 100 consecutive Cases treated since the Invention of the Laryngoscope by Morell Mackenzie, M.D. Lond., M.R.C.P., Physician to the Hospital for Diseases of the Throat. 8vo, with Coloured Plates, 12s. 6d. [1871]

IRRITATIVE DYSPEPSIA
and its Important Connection with Irritative Congestion of the Windpipe and with the Origin and Progress of Consumption by C. B. Garrett, M.D. Crown 8vo, 2s. 6d. [1868]

MINERAL SPRINGS OF HARROGATE
By Dr. Kennion. Revised and enlarged by Adam Bealey, M.A., M.D. Cantab., F.R.C.P. Lond. Seventh Thousand. Crown 8vo, 1s. [1875]

SKETCH OF CANNES AND ITS CLIMATE
by Th. De Valcourt, M.D. Paris, Physician at Cannes. Second Edition, with Photographic View and 6 Meteorological Charts. Crown 8vo, 2s. 6d. [1873]

WINTER AND SPRING
on the Shores of the Mediterranean; or, the Genoese Rivieras, Italy, Spain, Greece, the Archipelago, Constantinople, Corsica, Sardinia, Sicily, Corfu, Malta, Tunis, Algeria, Smyrna, Asia Minor, with Biarritz and Arcachon, as Winter Climates. By HENRY BENNET, M.D. Fifth Edition, post 8vo, with numerous Plates, Maps, and Engravings, 12s. 6d. [1874]

BY THE SAME AUTHOR,

TREATMENT OF PULMONARY CONSUMPTION
by Hygiene, Climate, and Medicine. Second Edition, 8vo, 5s. [1871]

EGYPT AS A HEALTH RESORT;
with Medical and other Hints for Travellers in Syria, by A. DUNBAR WALKER M.D. Fcap 8vo, 3s. 6d. [1873]

FAMILY MEDICINE FOR INDIA
A Manual, by WILLIAM J. MOORE, M.D., Surgeon-Major H.M. Indian Medical Service. Published under the Authority of the Government of India. Post 8vo, with 57 Engravings, 8s. 6d. [1874]

DISEASES OF TROPICAL CLIMATES
and their Treatment: with Hints for the Preservation of Health in the Tropics, by JAMES A. HORTON, M.D., Surgeon-Major, Army Medical Department. Post 8vo, 12s. 6d. [1874]

HEALTH IN INDIA FOR BRITISH WOMEN
and on the Prevention of Disease in Tropical Climates by EDWARD J. TILT, M.D., Consulting Physician-Accoucheur to the Farringdon General Dispensary. Fourth Edition, crown 8vo, 5s. [1875]

BAZAAR MEDICINES OF INDIA
and Common Medical Plants: Remarks on their Uses, with Full Index of Diseases, indicating their Treatment by these and other Agents procurable throughout India, &c., by EDWARD J. WARING, M.D., F.R.C.P. Lond., Retired Surgeon H.M. Indian Army. Third Edition. Fcap 8vo, 5s. [1875]

SOME AFFECTIONS OF THE LIVER
and Intestinal Canal; with Remarks on Ague and its Sequelæ, Scurvy, Purpura, &c., by STEPHEN H. WARD, M.D. Lond., F.R.C.P., Physician to the Seamen's Hospital, Greenwich. 8vo, 7s. [1872]

DISEASES OF THE LIVER:
Lettsomian Lectures for 1872 by S. O. HABERSHON, M.D., F.R.C.P., Senior Physician to Guy's Hospital. Post 8vo, 3s. 6d. [1872]

BY THE SAME AUTHOR.

DISEASES OF THE STOMACH: DYSPEPSIA
Second Edition, crown 8vo, 5s.

THE STOMACH AND DUODENUM

Their Morbid States and their Relations to the Diseases of other Organs, by SAMUEL FENWICK, M.D., F.R.C.P., Assistant-Physician to the London Hospital. 8vo, with 10 Plates, 12s. [1868]

CONSTIPATED BOWELS:

the Various Causes and the Different Means of Cure, by S. B. BIRCH, M.D., M.R.C.P. Third Edition, post 8vo, 3s. 6d. [1868]

FOOD AND DIETETICS

Physiologically and Therapeutically Considered. Second Edition, 8vo, 15s. [1875]

THE INDIGESTIONS;

or, Diseases of the Digestive Organs Functionally Treated, by T. K. CHAMBERS, M.D., F.R.C.P., Lecturer on Medicine at St. Mary's Hospital. Second Edition, 8vo, 10s. 6d. [1867]

IMPERFECT DIGESTION:

its Causes and Treatment by ARTHUR LEARED, M.D., F.R.C.P., Senior Physician to the Great Northern Hospital. Sixth Edition, fcap 8vo, 4s. 6d. [1875]

THE ISSUE OF A SPIRIT RATION

during the Ashanti Campaign of 1874; with two Appendices containing Experiments to show the Relative Effects of Rum, Meat Extract and Coffee during Marching, and the Use of Oatmeal Drink during Labour, by EDMUND A. PARKES, M.D., F.R.S., Professor of Hygiene to the Army Medical School, Netley. 8vo, 2s. 6d. [1875]

MEGRIM, SICK-HEADACHE,

and some Allied Disorders: a Contribution to the Pathology of Nerve-Storms, by EDWARD LIVEING, M.D. Cantab., Hon. Fellow of King's College, London. 8vo, with Coloured Plate, 15s. [1873]

IRRITABILITY:

Popular and Practical Sketches of Common Morbid States and Conditions bordering on Disease; with Hints for Management, Alleviation, and Cure, by JAMES MORRIS, M.D. Lond. Crown 8vo, 4s. 6d. [1868]

FUNCTIONAL NERVOUS DISORDERS

Studies by C. HANDFIELD JONES, M.B., F.R.C.P., F.R.S., Physician to St. Mary's Hospital. Second Edition, 8vo, 18s. [1870]

NEURALGIA AND KINDRED DISEASES

of the Nervous System: their Nature, Causes, and Treatment, with a series of Cases, by JOHN CHAPMAN, M.D., M.R.C.P. 8vo, 14s. [1878]

THE SYMPATHETIC SYSTEM OF NERVES

and their Functions as a Physiological Basis for a Rational System of Therapeutics by Edward Meryon, M.D., F.R.C.P., Physician to the Hospital for Diseases of the Nervous System. 8vo, 3s. 6d. [1872]

GOUT, RHEUMATISM

and the Allied Affections; a Treatise by P. Hood, M.D. Crown 8vo, 10s. 6d. [1871]

RHEUMATIC GOUT,

or Chronic Rheumatic Arthritis of all the Joints; a Treatise by Robert Adams, M.D., M.R.I.A., Surgeon to H.M. the Queen in Ireland, Regius Professor of Surgery in the University of Dublin. Second Edition, 8vo, with Atlas of Plates, 21s. [1872]

TEMPERATURE OBSERVATIONS

containing (1) Temperature Variations in the Diseases of Children, (2) Puerperal Temperatures, (3) Infantile Temperatures in Health and Disease, by Wm. Squire, M.R.C.P. Lond. 8vo, 5s. [1871]

MYCETOMA;

or, the Fungus Disease of India, by H. Vandyke Carter, M.D., Surgeon-Major H.M. Indian Army. 4to, with 11 Coloured Plates, 42s. [1874

THE ORIGIN OF CANCER

considered with Reference to the Treatment of the Disease by Campbell de Morgan, F.R.S., F.R.C.S., Surgeon to the Middlesex Hospital. Crown 8vo, 3s. 6d. [1872]

CANCER:

its varieties, their Histology and Diagnosis, by Henry Arnott, F.R.C.S., Assistant-Surgeon to, and Lecturer on Morbid Anatomy at, St. Thomas's Hospital. 8vo, with 5 Plates and 22 Engravings, 5s. 6d. [1872]

CANCEROUS AND OTHER INTRA-THORACIC GROWTHS:

their Natural History and Diagnosis, by J. Risdon Bennett, M.D., F.R.C.P., Member of the General Medical Council. Post 8vo, with Plates, 8s. [1872]

CERTAIN FORMS OF CANCER

with a New and successful Mode of Treating it, to which is prefixed a Practical and Systematic Description of all the varieties of this Disease, by Alex. Marsden, M.D., F.R.C.S.E., Consulting Surgeon to the Royal Free Hospital, and Senior Surgeon to the Cancer Hospital. Second Edition, with Coloured Plates, 8vo, 8s. 6d. [1873

ATLAS OF SKIN DISEASES:

a series of Illustrations, with Descriptive Text and Notes upon Treatment. By TILBURY FOX, M.D., F.R.C.P., Physician to the Department for Skin Diseases in University College Hospital. In monthly parts, roy. 4to, each containing Four Coloured Plates. Parts I to V issued since October. 6s. 6d. each. [1875]

DISEASES OF THE SKIN:

a System of Cutaneous Medicine by ERASMUS WILSON, F.R.C.S., F.R.S. Sixth Edition, 8vo, 18s., with Coloured Plates, 36s. [1867]

BY THE SAME AUTHOR,

LECTURES ON EKZEMA

and Ekzematous Affections: with an Introduction on the General Pathology of the Skin, and an Appendix of Essays and Cases. 8vo, 10s. 6d. [1870]

ALSO,

LECTURES ON DERMATOLOGY

delivered at the Royal College of Surgeons, 1870, 6s.; 1871-3, 10s. 6d., 1874-5, 10s. 6d.

ECZEMA

by McCALL ANDERSON, M.D., Professor of Clinical Medicine in the University of Glasgow. Third Edition, 8vo, with Engravings, 7s. 6d. [1874]

BY THE SAME AUTHOR,

PARASITIC AFFECTIONS OF THE SKIN

Second Edition, 8vo, with Engravings, 7s. 6d. [1868]

PSORIASIS OR LEPRA

by GEORGE GASKOIN, M.R.C.S., Surgeon to the British Hospital for Diseases of the Skin. 8vo, 5s. [1875]

DISEASES OF THE SKIN

in Twenty-four Letters on the Principles and Practice of Cutaneous Medicine, by HENRY EVANS CAUTY, Surgeon to the Liverpool Dispensary for Diseases of the Skin, 8vo, 12s. 6d. [1874]

FOURTEEN COLOURED PHOTOGRAPHS OF LEPROSY

as met with in the Straits Settlements, with Explanatory Notes by A. F. ANDERSON, M.D., Acting Colonial Surgeon, Singapore. 4to, 31s. 6d. [1872]

WORMS:

a Series of Lectures delivered at the Middlesex Hospital on Practical Helminthology by T. SPENCER COBBOLD, M.D., F.R.S. Post 8vo, 5s. [1872]

OXYGEN:
its Action, Use, and Value in the Treatment of Various Diseases otherwise Incurable or very Intractable, by S. B. Birch, M.D., M.R.C.P. Second Edition, post 8vo, 3s. 6d. [1868]

THE MEDICAL ADVISER IN LIFE ASSURANCE
by Edward Henry Sieveking, M.D., F.R.C.P., Physician to St. Mary's and the Lock Hospitals; Physician-Extraordinary to the Queen; Physician-in-Ordinary to the Prince of Wales, &c. Crown 8vo, 6s. [1874]

THE LAWS AFFECTING MEDICAL MEN
a Manual by Robert G. Glenn, LL.B., Barrister-at-Law; with a Chapter on Medical Etiquette by Dr. A. Carpenter. 8vo, 14s. [1871]

MEDICAL JURISPRUDENCE
(Principles and Practice of) by Alfred S. Taylor, M.D., F.R.C.P., F.R.S. Second Edition, 2 vols., 8vo, with 189 Engravings, £1 11s. 6d. [1873]

BY THE SAME AUTHOR,

A MANUAL OF MEDICAL JURISPRUDENCE
Ninth Edition. Crown 8vo, with Engravings. 14s. [1874]

ALSO,

POISONS
in Relation to Medical Jurisprudence and Medicine. Third Edition, crown 8vo, with 104 Engravings, 16s. [1875]

A TOXICOLOGICAL CHART,
exhibiting at one View the Symptoms, Treatment, and mode of Detecting the various Poisons—Mineral, Vegetable, and Animal: with Concise Directions for the Treatment of Suspended Animation, by William Stowe, M.R.C.S.E. Thirteenth Edition, 2s.; on roller, 5s. [1872]

MADNESS
in its Medical, Legal, and Social Aspects, Lectures by Edgar Sheppard, M.D., M.R.C.P., Professor of Psychological Medicine in King's College; one of the Medical Superintendents of the Colney Hatch Lunatic Asylum. 8vo, 6s. 6d. [1873]

HANDBOOK OF LAW AND LUNACY;
or, the Medical Practitioner's Complete Guide in all Matters relating to Lunacy Practice, by J. T. Sabben, M.D., and J. H. Balfour Browne, Barrister-at-Law. 8vo, 5s. [1872]

OBSCURE DISEASES OF THE BRAIN AND MIND
by Forbes Winslow, M.D., D.C.L. Oxon. Fourth Edition, post 8vo, 10s. 6d. [1868]

PSYCHOLOGICAL MEDICINE:
a Manual, containing the Lunacy Laws, the Nosology, Ætiology, Statistics, Description, Diagnosis, Pathology (including Morbid Histology), and Treatment of Insanity, by J. C. Bucknill, M.D., F.R.S., and D. H. Tuke, M.D., F.R.C.P. Third Edition, 8vo, with 10 Plates and 34 Engravings, 25s. [1873]

CEREBRIA
and other Diseases of the Brain by Charles Elam, M.D., F.R.C.P., Assistant-Physician to the National Hospital for Paralysis and Epilepsy. 8vo, 6s. [1872]

INFLUENCE OF THE MIND UPON THE BODY
in Health and Disease, Illustrations designed to elucidate the Action of the Imagination, by Daniel Hack Tuke, M.D., F.R.C.P. 8vo, 14s. [1872]

A MANUAL OF PRACTICAL HYGIENE
by E. A. Parkes, M.D., F.R.C.P., F.R.S., Professor of Hygiene in the Army Medical School. Fourth Edition, 8vo, with Plates and Engravings, 16s. [1873]

A HANDBOOK OF HYGIENE
for the Use of Sanitary Authorities and Health Officers by George Wilson, M.D. Edin., Medical Officer of Health for the Warwick Union of Sanitary Authorities. Second Edition, crown 8vo, with Engravings, 8s. 6d. [1873]

MICROSCOPICAL EXAMINATION OF DRINKING WATER
A Guide, by John D. Macdonald, M.D., F.R.S., Assistant Professor of Naval Hygiene, Army Medical School. 8vo, with 24 Plates, 7s. 6d. [1875]

HANDBOOK OF MEDICAL ELECTRICITY
by Herbert Tibbits, M.D., M.R.C.P.E., Medical Superintendent of the National Hospital for the Paralysed and Epileptic. 8vo, with 64 Engravings, 6s. [1873]

CLINICAL USES OF ELECTRICITY
Lectures delivered at University College Hospital by J. Russell Reynolds, M.D. Lond., F.R.C.P., F.R.S., Professor of Medicine in University College. Second Edition, post 8vo, 3s. 6d. [1873]

MEDICO-ELECTRIC APPARATUS
and How to Use it; or, a Practical Description of every Form of Medico-Electric Apparatus in Modern Use, with Plain Directions for Mounting, Charging, and Working, by T. P. Salt. 8vo, with 31 Engravings, 2s. 6d. [1875]

AUTOBIOGRAPHICAL RECOLLECTIONS

of the Medical Profession, being personal reminiscences of many distinguished Medical Men during the last forty years, by J. Fernandez Clarke, M.R.C.S., for many years on the Editorial Staff of the 'Lancet.' Post 8vo, 10s. 6d. [1874]

A DICTIONARY OF MEDICAL SCIENCE

containing a concise explanation of the various subjects and terms of Anatomy, Physiology, Pathology, Hygiene, Therapeutics, Medical Chemistry, Pharmacology, Pharmacy, Surgery, Obstetrics, Medical Jurisprudence and Dentistry; Notices of Climate and Mineral Waters; formulæ for Officinal, Empirical, and Dietetic Preparations; with the Accentuation and Etymology of the terms and the French and other Synonyms, by Robley Dunglison, M.D., LL.D. New Edition, by Richard J. Dunglison, M.D. Royal 8vo, 28s. [1874]

A MEDICAL VOCABULARY;

being an Explanation of all Terms and Phrases used in the various Departments of Medical Science and Practice, giving their derivation, meaning, application, and pronunciation, by Robert G. Mayne, M.D., LL.D. Fourth Edition, fcap 8vo, 10s. [1875]

ATLAS OF OPHTHALMOSCOPY:

representing the Normal and Pathological Conditions of the Fundus Oculi as seen with the Ophthalmoscope: composed of 12 Chromo-lithographic Plates (containing 59 Figures), accompanied by an Explanatory Text by R. Liebreich, Ophthalmic Surgeon to St. Thomas's Hospital. Translated into English by H. Rosborough Swanzy, M.B. Dub. Second Edition, 4to, £1 10s. [1870]

DISEASES OF THE EYE

a Manual by C. Macnamara, Surgeon to the Calcutta Ophthalmic Hospital Second Edition, fcap 8vo, with Coloured Plates, 12s. 6d. [1872]

DISEASES OF THE EYE

A Treatise by J. Soelberg Wells, F.R.C.S., Ophthalmic Surgeon to King's College Hospital and Surgeon to the Royal London Ophthalmic Hospital. Third Edition, 8vo, with Coloured Plates and Engravings, 25s. [1873]

BY THE SAME AUTHOR,

LONG, SHORT, AND WEAK SIGHT,

and their Treatment by the Scientific use of Spectacles. Fourth Edition, 8vo, 6s. [1873]

DISEASES OF THE EYE

A Practical Treatise by Haynes Walton, F.R.C.S., Surgeon to St. Mary's Hospital and in charge of its Ophthalmological Department. Third Edition, 8vo, with 3 Plates and nearly 300 Engravings, 25s. [1875]

OPHTHALMIC MEDICINE AND SURGERY
a Manual by T. WHARTON JONES, F.R.S., Professor of Ophthalmic Medicine and Surgery in University College. Third Edition, fcap 8vo, with 9 Coloured Plates and 173 Engravings, 12s. 6d. [1865]

DISEASES OF THE EYE
Illustrations of, with an Account of their Symptoms, Pathology, and Treatment, by HENRY POWER, F.R.C.S., M.B. Lond., Ophthalmic Surgeon to St. Bartholomew's Hospital. 8vo, with 12 Coloured Plates, 20s. [1867]

A SYSTEM OF DENTAL SURGERY
by JOHN TOMES, F.R.S., and CHARLES S. TOMES, M.A., Lecturer on Dental Anatomy and Physiology, and Assistant Dental Surgeon to the Dental Hospital of London. Second Edition, fcap 8vo, with 268 Engravings, 14s. [1873]

A MANUAL OF DENTAL MECHANICS
with an Account of the Materials and Appliances used in Mechanical Dentistry, by OAKLEY COLES, L.D.S., R.C.S., Surgeon-Dentist to the Hospital for Diseases of the Throat. Crown 8vo, with 140 Engravings, 7s. 6d. [1873]

HANDBOOK OF DENTAL ANATOMY
and Surgery for the use of Students and Practitioners by JOHN SMITH, M.D., F.R.S. Edin., Surgeon-Dentist to the Queen in Scotland. Second Edition, fcap 8vo, 4s. 6d. [1871]

EPIDEMIOLOGY;
or, the Remote Cause of Epidemic Diseases in the Animal and in the Vegetable Creation, by JOHN PARKIN, M.D., F.R.C.S. Part I, 8vo, 5s. [1873]

GERMINAL MATTER AND THE CONTACT THEORY:
an Essay on the Morbid Poisons by JAMES MORRIS, M.D. Lond. Second Edition, crown 8vo, 4s. 6d. [1867]

DISEASE GERMS;
and on the Treatment of the Feverish State, by LIONEL S. BEALE, M.B., F.R.C.P., F.R.S., Physician to King's College Hospital. Second Edition, crown 8vo, with 28 Plates, 12s. 6d. [1872]

THE GRAFT THEORY OF DISEASE
being an Application of Mr. DARWIN'S Hypothesis of Pangenesis to the Explanation of the Phenomena of the Zymotic Diseases, by JAMES ROSS, M.D. 8vo, 10s. [1872]

ZYMOTIC DISEASES:
their Correlation and Causation by A. WOLFF, F.R.C.S. Post 8vo, 5s. [1872]

The following CATALOGUES issued by Messrs CHURCHILL will be forwarded post free on application:

1. *Messrs Churchill's General List of nearly* 600 *works on Medicine, Surgery, Midwifery, Materia Medica, Hygiene, Anatomy, Physiology, Chemistry, &c., &c., with a complete Index to their Titles, for easy reference.*

N.B.—*This List includes Nos.* 2 *and* 3.

2. *Selection from Messrs Churchill's General List, comprising all recent Works published by them on the Art and Science of Medicine.*

3. *A descriptive List of Messrs Churchill's Works on Chemistry, Pharmacy, Botany, Photography, Zoology, and other branches of Science.*

4. *Messrs Churchill's Red-Letter List, giving the Titles of forthcoming New Works and New Editions.*

[Published every October.]

5. *The Medical Intelligencer, an Annual List of New Works and New Editions published by Messrs J. & A. Churchill, together with Particulars of the Periodicals issued from their House.*

[Sent in January of each year to every Medical Practitioner in the United Kingdom whose name and address can be ascertained. A large number are also sent to the United States of America, Continental Europe, India, and the Colonies.]

MESSRS CHURCHILL have a special arrangement with MESSRS LINDSAY & BLAKISTON, OF PHILADELPHIA, in accordance with which that Firm act as their Agents for the United States of America, either keeping in Stock most of Messrs CHURCHILL's Books, or reprinting them on Terms advantageous to Authors. Many of the Works in this Catalogue may therefore be easily obtained in America.

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.